NOTICE OF CORRECTION

A typographical error was identified in *Engineering Evaluation/Cost Analysis for the CPP-603A Basin Non-time Critical Removal Action, Idaho Nuclear Technology and Engineering Center, DOE/NE-ID-11140, Revision 0, July 2004.* A revised document, *Engineering Evaluation/Cost Analysis for the CPP-603A Basin Non-time Critical Removal Action, Idaho Nuclear Technology and Engineering Center, DOE/NE-ID-11140, Revision 1, August 2004* has replaced Revision 0. The following sentence in Section 2.3, page 8 of Revision 0 is changed, as follows:

"The contamination has penetrated the basins' porous cement walls and has measured at 150 R/hr beta-gamma."

This sentence has been replaced with the corrected sentence:

"The contamination has penetrated the basins' porous cement walls and has measured at 150 mR/hr beta-gamma."

Bart Richards	08/26/04
Document Owner	**Date**

DOE/NE-ID-11140
Revision 1
August 2004

U.S. Department of Energy
Idaho Operations Office

Engineering Evaluation/Cost Analysis for the CPP-603A Basin Non-Time Critical Removal Action, Idaho Nuclear Technology and Engineering Center

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DOE/NE-ID-11140
Revision 1
Project No. 23943

Engineering Evaluation/Cost Analysis for the CPP-603A Basin Non-Time Critical Removal Action, Idaho Nuclear Technology and Engineering Center

August 2004

Prepared for the
U.S. Department of Energy
DOE Idaho Operations Office

ABSTRACT

This Engineering Evaluation/Cost Analysis assists the U.S. Department of Energy in identifying the preferred response alternative for the CPP-603 Basins. It is intended to (1) satisfy environmental review requirements for the removal action, (2) provide a framework for evaluating and selecting alternative technologies, and (3) satisfy Administrative Record requirements for documentation of the removal action selection. This Engineering Evaluation/Cost Analysis identifies the objectives of the removal action and analyzes the effectiveness, implementability, and cost of various alternatives that could satisfy these objectives.

EXECUTIVE SUMMARY

The U.S. Department of Energy has used water to shield spent nuclear fuel and protect Idaho National Engineering and Environmental Laboratory (INEEL) workers from radiation; however, water is also the primary means of mobilizing contamination from surface releases to the Snake River Plain Aquifer. Older fuel storage basins are not double-walled and pose a greater threat to the aquifer than newer double-walled basins. An important step to protect the aquifer is removal of spent nuclear fuel from older fuel storage basins and removal of the water no longer needed for shielding. The U.S. Department of Energy is proposing to remove the water from the CPP-603A nuclear fuel storage basins at the Idaho Nuclear Technology and Engineering Center using a Comprehensive Environmental Response, Compensation, and Liability Act non-time critical removal action. The scope of the removal action being proposed is limited to the contents of the CPP-603A Basins.

This action is being proposed as a non-time critical removal action. Under a non-time critical removal action, action can be taken to abate, prevent, minimize, stabilize, mitigate, or reduce the release or threat of release of contaminants. An engineering evaluation/cost analysis is required under 40 *Code of Federal Regulations* 300.415(b)(4)(1) of the "National Oil and Hazardous Substances Pollution Contingency Plan" for all non-time critical removal actions.

Even actions that remove a threat to the aquifer must be accomplished in compliance with regulations. Each INEEL fuel storage basin has had a different operating history and has different characteristics. The characteristics of the CPP-603A nuclear fuel storage basins require compliance with hazardous waste management regulations in addition to environmental protection regulations. This Engineering Evaluation/Cost Analysis provides the public with a comparison of alternative methods of removing the water in the CPP-603A nuclear fuel storage basins. The alternatives were developed in steps from taking no action to removing all basin components. Some of the alternatives do not comply with regulations. These alternatives are included in the Engineering Evaluation/Cost Analysis so that the public will know that the alternatives were considered and can understand why they were rejected.

The recommended alternative is to remove and treat basin sludge, remove basin water while filling the basins with grout, encapsulate debris items contaminated with radioactive cobalt in the grout, and use the grout to provide shielding for the radioactive contamination imbedded in the basin walls. The sludge will be treated for disposal in a lined, monitored landfill. The water will be put in the ICDF evaporation pond and evaporated. The radioactive cobalt in the encapsulated debris items will decay to background levels before the CPP-603 fuel operations are complete. The final decontamination and disposal of the basin structure will be completed when the entire CPP-603 Complex is taken out of service.

This alternative reduces the potential risk to the aquifer; satisfies the remedial action objectives of the *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13*; protects site workers taking the action; complies with regulations; and is cost effective.

This Engineering Evaluation/Cost Analysis will become part of the INEEL Administrative Record. It is made available for public comment. The INEEL

Administrative Record is on the Internet at http://ar.inel.gov/ and is available to the public at the following locations:

Albertson's Library Boise State University 1910 University Drive Boise, ID 83725 (208) 426-1625	INEEL Technical Library DOE Public Reading Room 1776 Science Center Drive Idaho Falls, ID 83415 (208) 526-1185

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
ARC	allowable residual contamination
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
CPP	Chemical Processing Plant
DEQ	Idaho Department of Environmental Quality
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EDF	engineering design file
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
HWMA	Hazardous Waste Management Act
ICDF	INEEL CERCLA Disposal Facility
ID	identification
IDAPA	Idaho Administrative Procedures Act
IFSF	Irradiated Fuel Storage Facility
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MCL	maximum contaminant level
MEI	maximally exposed individual
NA	not available
NCRP	National Council on Radiation Protection
NEPA	National Environmental Policy Act
O&M	operations and maintenance

OU	operable unit
PEWE	Process Equipment Waste Evaporator
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI/BRA	remedial investigation/baseline risk assessment
SAR	safety analysis report
SF	slope factor
SHADO	small, high-activity debris object
TBC	to be considered
USC	United States Code

Engineering Evaluation/Cost Analysis for the CPP-603A Basin Non-Time Critical Removal Action, Idaho Nuclear Technology and Engineering Center

1. INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA)—prepared in accordance with Section 300.415(b)(4)(i) of the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300)—assists the U.S. Department of Energy (DOE) in identifying the preferred response alternative for the CPP-603 Basins. It is intended to (1) satisfy environmental review requirements for the removal action, (2) provide a framework for evaluating and selecting alternative technologies, and (3) satisfy Administrative Record requirements for documentation of the removal action selection. This EE/CA identifies the objectives of the removal action and analyzes the effectiveness, implementability, and cost of various alternatives that could satisfy these objectives.

This EE/CA utilizes information on the actions identified for CPP-603A facility disposition in earlier National Environmental Policy Act (NEPA) documents. Initially, disposition of CPP-603A was evaluated in the *Record of Decision, Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs* (DOE-ID 1995). For the proposed deactivation of CPP-603A, the 1995 Record of Decision states: "Implementation decisions will be made in the future pending further project definition, funding priorities, and any further review under the CERCLA or NEPA."

In June 2001, a draft environmental assessment was prepared to evaluate the CPP-603A facility. This draft environmental assessment—*Deactivation, Decommissioning, and Dismantlement of the CPP-603 Basin Project, Draft Environmental Assessment* (DOE 2001)—also evaluated the deactivation, decontamination, and decommissioning of the CPP-603 facility, including the Fuel Receiving and Storage Facility. The alternatives ranged from a no-action alternative to complete removal. The proposed action included evaporating the basin water, filling the basins with grout, and demolishing and disposing of the superstructure. However, this environmental assessment was rescinded when it was determined that additional characterization was necessary for the sludge in the bottoms of the basins. This sludge characterization has been completed, and it is described in Section 2.4.

Now that efforts have been completed to more accurately characterize the basins' contents, the DOE has chosen to move forward with deactivation of the basins through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) non-time critical removal action process. Consistent with the 1995 Facility Environmental Impact Statement and the alternatives evaluated in the previous NEPA documents, this EE/CA evaluates alternatives for effectively closing the basins in a configuration that will be protective of human health and the environment and compatible with future deactivation, decontamination, and decommissioning activities at the CPP-603 Complex.

Currently, the basins are kept full of water to provide shielding for a spent nuclear fuel-like item (a small high-activity debris object designated SHADO 1 [EDF-4271]); other items containing fission material; basin sludge, which contains activated metals; and radioactive contamination adhering to and/or embedded in the interior basin surfaces. Characterization of the basin sludge showed it also contains significant levels of cadmium. The sludge must be managed in compliance with Idaho's hazardous material regulations. The proposed non-time critical removal action will provide an umbrella for the entire basin deactivation while ensuring compliance with all applicable regulations.

After an alternative is selected, an action memorandum will be issued and placed in the INEEL Administrative Record. The removal action may then proceed, but the basins will be considered operational as long as water shielding is required.

2. SITE CHARACTERIZATION

This section briefly discusses the background of the CPP-603A Basins—in particular, the nature and extent of contamination and a streamlined evaluation of associated risks if no action is taken. Much of this information has been extracted from the *Deactivation, Decommissioning, and Dismantlement of the CPP-603 Basin Project, Draft Environmental Assessment* (DOE 2001).

2.1 Site Description and Background

2.1.1 Idaho National Engineering and Environmental Laboratory

The Idaho National Engineering and Environmental Laboratory (INEEL), managed by DOE, is a government facility located 51 km (32 mi) west of Idaho Falls, Idaho. The INEEL occupies 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain. In 1949, the U.S. Atomic Energy Commission established the INEEL, which was called the National Reactor Testing Station at that time. Its purpose was to conduct nuclear energy research and related activities. It was re-designated the Idaho National Engineering Laboratory in 1974 and then the INEEL in 1997 to reflect expansion of its mission to include a broader range of engineering and environmental management activities.

The DOE controls all land within the INEEL, and public access is restricted to public highways, DOE-sponsored tours, special-use permits, and the Experimental Breeder Reactor I National Historic Landmark. In addition, DOE accommodates Shoshone-Bannock tribal member access to areas on the INEEL for cultural and religious purposes.

The INEEL is located primarily in Butte County; however, it also occupies portions of Bingham, Bonneville, Clark, and Jefferson counties. The 2000 census indicated the following populations (in parentheses) for cities in the region:

- Idaho Falls (50,730)
- Pocatello (51,466)
- Blackfoot (10,419)
- Arco (1,026)
- Atomic City (25).

Surface water flows on the INEEL consist mainly of three streams draining intermountain valleys to the north and northwest of the Site: (1) the Big Lost River, (2) the Little Lost River, and (3) Birch Creek. Flows from Birch Creek and the Little Lost River seldom reach the INEEL because of irrigation withdrawals upstream. The Big Lost River and Birch Creek usually flow onto the INEEL before the irrigation season or during high water years.

2.1.2 Idaho Nuclear Technology and Engineering Center and CPP-603A

The Idaho Nuclear Technology and Engineering Center (INTEC), located in the south-central area of the INEEL (Figures 1 and 2), began operations in 1952. Historically, spent nuclear fuel from defense projects was reprocessed to separate reusable uranium from spent nuclear fuel. In 1992, DOE discontinued reprocessing. Liquid waste generated from past fuel processing is stored in an underground

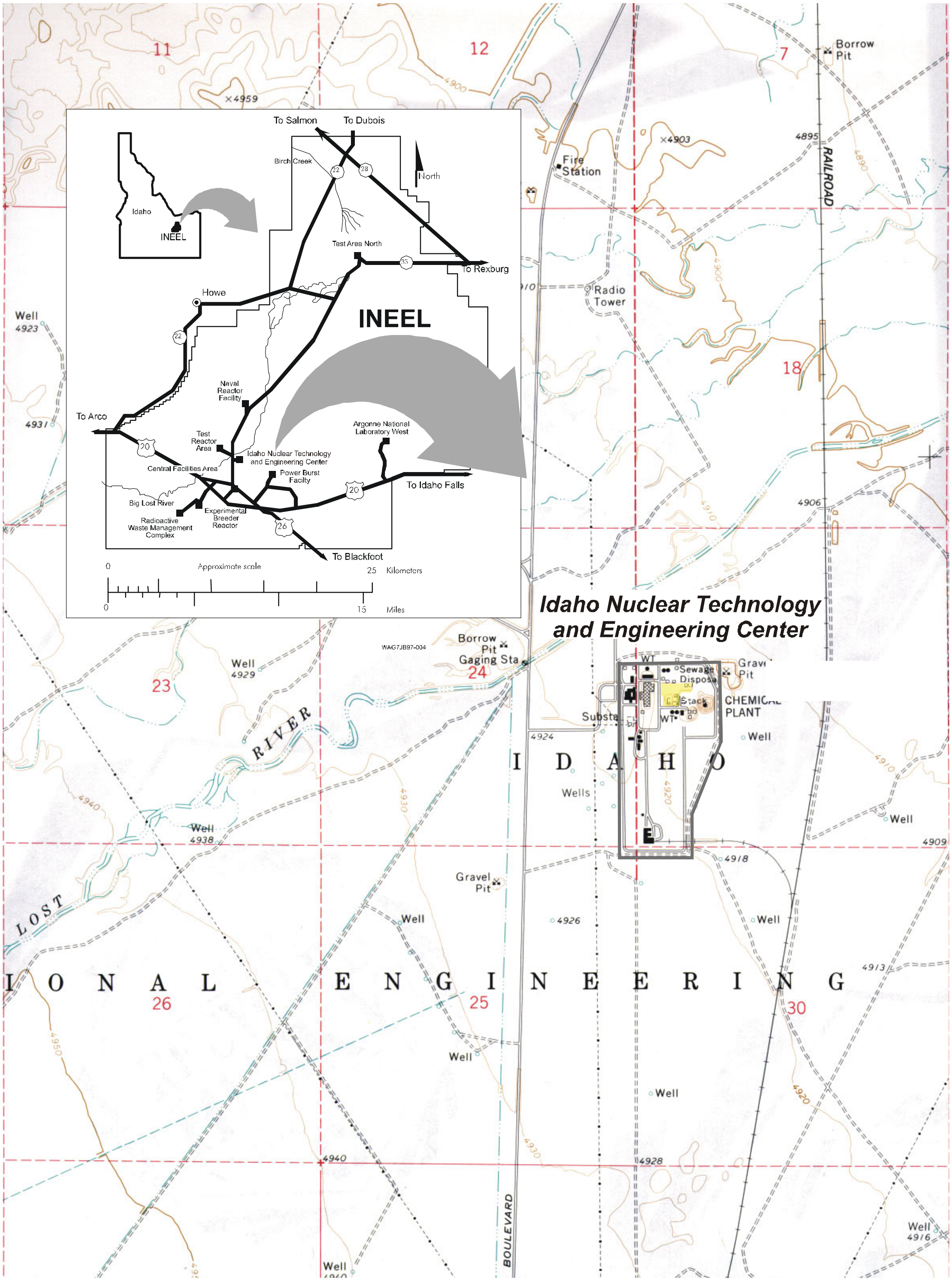

Figure 1. Location of the Idaho Nuclear Technology and Engineering Center on the Idaho National Engineering and Environmental Laboratory Site.

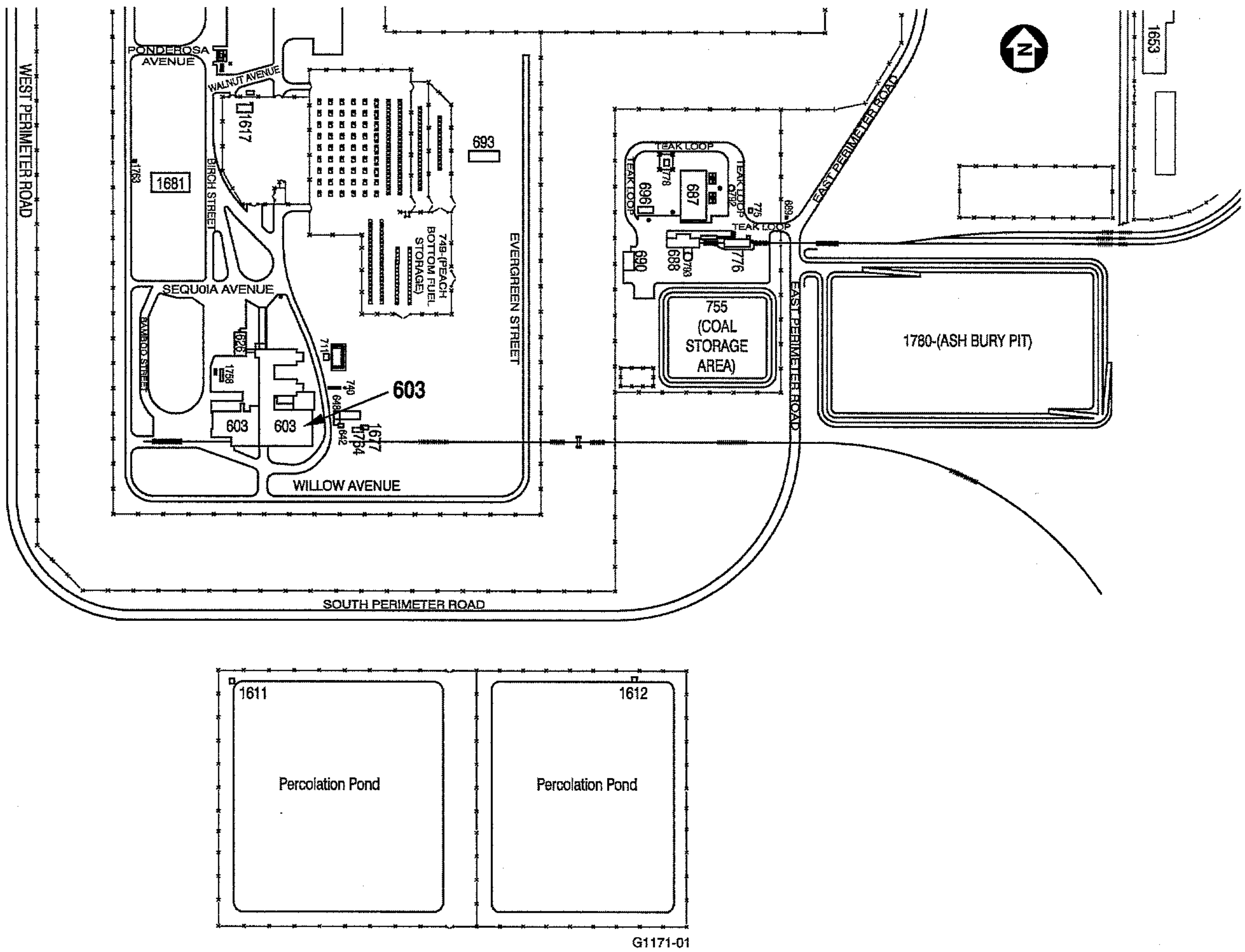

Figure 2. Plan view of the southern portion of the Idaho Nuclear Technology and Engineering Center.

tank farm. This liquid waste was treated using a calcining process to convert the liquid to a more stable granular form. Calcined solids are stored in stainless steel bins. Disposition of liquid waste and calcined solids is addressed in the *Idaho High-Level Waste & Facilities Disposition Final Environmental Impact Statement* (DOE-ID 2002). The current mission for INTEC is to receive and temporarily store spent nuclear fuel and radioactive waste for future disposition, manage waste, and perform remedial actions.

Pending reprocessing, spent nuclear fuel was stored underwater in basins, including CPP-603A (Figure 3). By the year 2000, all inventoried spent nuclear fuel was removed from the facility's underwater storage basins and placed in newer underwater or dry storage facilities on the INEEL. The inactive water treatment system used to maintain the quality of the CPP-603 basin water will be closed separately under the INEEL Voluntary Consent Order, in accordance with the requirements of the Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA). The CPP-603A Basins are no longer needed for fuel storage; however, they are still in use to provide shielding and either must be maintained so the basins do not present a threat to public or worker health and safety or they must be isolated from the environment. The DOE needs to eliminate the risk and costs associated with maintaining this facility and its associated processes, because both environmental risk and cost risk will increase as the facility ages. Therefore, DOE is initiating this non-time critical removal action to reduce or eliminate the risks associated with maintaining this facility.

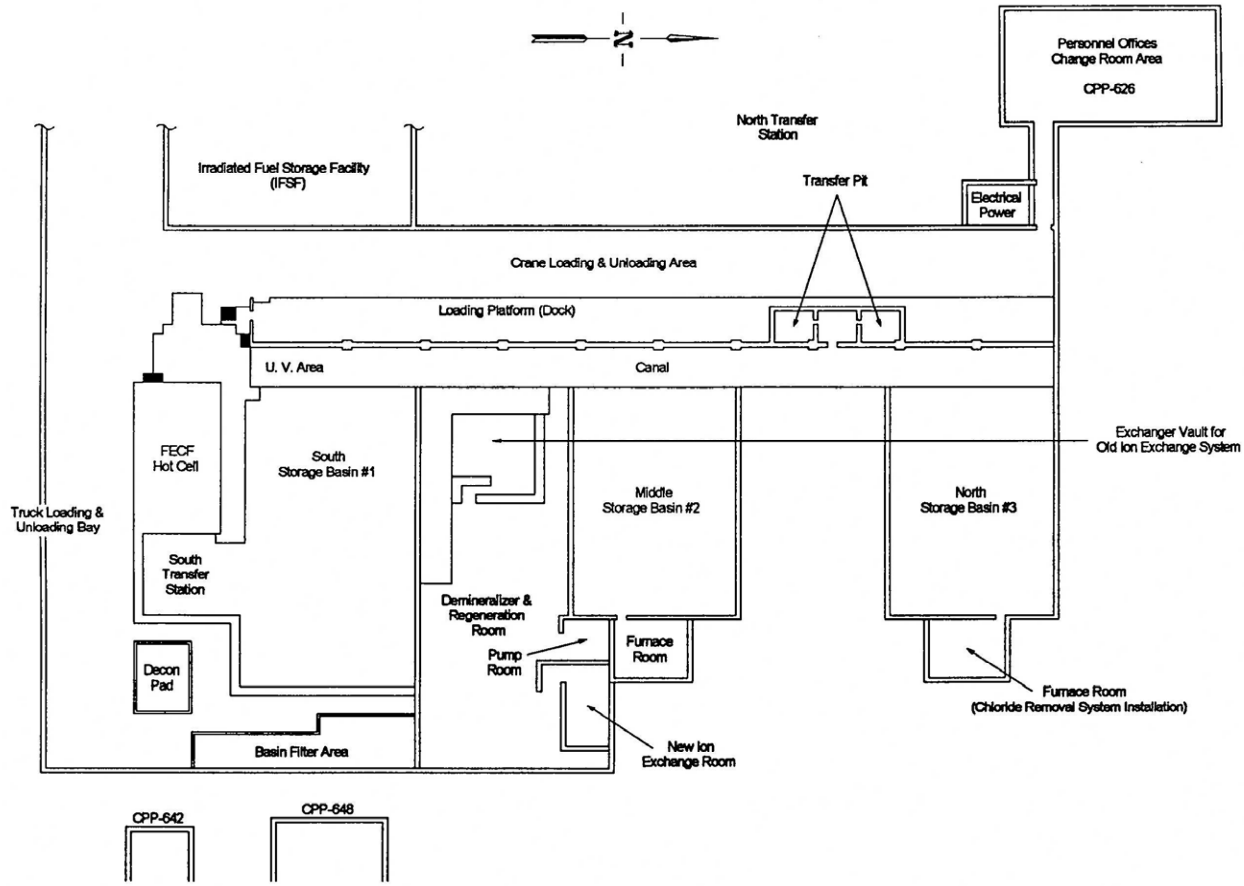

Figure 3. Plan view of a portion of the CPP-603 building showing the basins.

The CPP-603 building comprises two primary spent nuclear fuel facilities, including the CPP-603A Basin Facility and the CPP-603B Irradiated Fuel Storage Facility (IFSF). The CPP-603A Basin Facility contains three underwater fuel storage basins and a fuel element cutting cell. The CPP-603A was used to receive, unload, and provide underwater storage for fuel. The Fuel Element Cutting Facility, which was previously used for cutting fuel, is located in the CPP-603A Basin Facility portion of the building. In CPP-603B, the IFSF provides handling and dry storage for spent fuels.

The CPP-603B building includes the IFSF and the East-West Truck Bay. The IFSF is in service and is used for handling and dry storage of graphite-based fuel and other fuels. In addition, the CPP-626, CPP-1677, CPP-764, and VES-SFE-126 buildings will remain in service to support the IFSF operation (see Figures 2 and 3).

There are four other buildings associated with CPP-603: (1) CPP-626, (2) CPP-648, (3) CPP-1677, and (4) CPP-764. The CPP-626 building contains a change room and offices. The CPP-764 building is an underground vault that houses the VES-SFE-126 storage vessel (liquid waste collection tank) and its associated valves. The CPP-1677 building is a relatively new, abovegrade building associated with VES-SFE-126. The CPP-648 building is associated with the underground tank vault containing VES-SFE-106, the radioactive solids, and liquid waste storage vessel.

2.1.3 CPP-603A Basins and Canal

The DOE began construction of CPP-603 in the early 1950s, and the underwater storage basins began operation in 1953. The basins have been used to store spent nuclear fuel from the time they were placed in service and will not be declared inactive until DOE issues the action memorandum for this removal action. The facility was constructed to seismic criteria, construction codes, and safety requirements of the early 1950s. In addition, the basins (which were constructed of reinforced concrete) have no secondary liners. Currently, the basins are maintained full of water to prevent exposure to the radionuclides in the basins' sludge and debris, as well as to radioactive contamination affixed to the basin walls.

The storage basins are reinforced concrete structures with most of their volume below grade. Each of the three basins is filled with water. The combined volume of water in the storage basins and transfer canal is approximately 5.30E+06 L (1.40E+06 gal).

The north and middle basins are 18 m (60 ft) long, 12 m (40 ft) wide, and 6.5 m (21 ft) deep. Each of the basins is 1.28E+03 m^3 (1.67E+03 yd^3) in volume. The basins and transfer canal are covered with fiberglass grating and a radiation shield consisting of lead plate sandwiched between aluminum plates. The shielding is present primarily for activity associated with accumulation of a residue ring on the basins and transfer canals' walls at the surface of the water. Concrete beams, 0.6 m (2 ft) high and 0.3 m (1 ft) wide on 0.6-m (2-ft) centers, support the grating and radiation shield. Concrete dividers are located on the bottom of the basins. The beams, concrete dividers, and other fixtures were designed to sustain the spent nuclear fuel in a safe configuration.

Spent nuclear fuel stored in the north and middle basins was suspended under water from monorails located approximately 3 m (8 ft) above the basin walls. Small, 4-cm (1.5-in.) -wide continuous slots in the grating under the track allowed the fuel to move to its storage location.

The south basin is an open basin, 14 m (45 ft) × 27 m (88 ft) in area and 6.5 m (21 ft) deep. The total volume of the south basin is 1.93E+03 m^3 (2.52E+03 yd^3). Fuel was placed in the south basin in aluminum or stainless steel racks. The racks were accessed using a catwalk crane located above the basin. The racks have been removed from the basins. The south basin contains three storage boxes. The 1 × 1 × 1.2-m (3 × 3 × 4-ft) open-top carbon steel boxes contain miscellaneous basin debris.

A 2.5 × 650 × 6.5-m (8 × 200 × 21-ft) transfer canal connects the three storage basins. A floor grating overlaid with lead-plate shielding covers the transfer canal. The monorail track extends overhead on both sides of the transfer canal. In addition, continuous slots are located in the transfer canal grating to facilitate movement of the fuel to the appropriate storage basin.

The floors of the storage basins are covered with a layer of sediment. The sediment (which is referred to in this document as sludge) consists of desert sand, dust, precipitated corrosion products, and residuals from past cutting operations.

This non-time critical removal action applies to the CPP-603A Basins, including the Fuel Element Cutting Facility, the overflow pit, and the transfer channel. Deactivation, decontamination, and decommissioning of the other currently unused portions of CPP-603A will be coordinated with the final deactivation, decontamination, and decommissioning of the CPP-603 Complex. The CPP-603B (IFSF) will be expected to remain active until approximately 2035. Currently, the basin water treatment system is being closed under the Voluntary Consent Order to the requirements of HWMA/RCRA. Preparation to close the VES-SFE-106 waste tank system in accordance with HWMA/RCRA requirements also is underway.

2.2 Previous Closure/Cleanup Activities at the CPP-603A Basins

In 1978, a cleanup project was undertaken to remove sludge from the CPP-603A Basins. Concentrated sludge was pumped to the VES-SFE-106 tank and then to concrete, steel-lined tanks. The sludge was later solidified and disposed of at the Radioactive Waste Management Complex as low-level radioactive waste.

In 2000, all inventoried spent nuclear fuel was removed from the CPP-603A Basins. The Peach Bottom fuel was removed from the Fuel Element Cutting Facility in April 2004. The aluminum and stainless steel racks that supported the spent nuclear fuel also were removed from the basins. Currently, the basins are kept full of water to provide shielding for spent nuclear fuel-like items (e.g., SHADO), other items containing fissile material (e.g., sludge), and activated metals—all with significant radioactivity—as well as radioactive contamination adhering to and/or embedded in the interior basin surfaces.

2.3 Source, Nature, and Extent of Contamination

Over time, approximately 41,512 L (1,467 ft^3) of sludge, with an estimated mass of 49,300 kg (109,000 lb), has accumulated on the bottom of the basins. The average depth of sludge on the basins' floors is 3.66 cm (1.44 in.) (EDF-4235). The sludge comprises desert sand, dust, precipitated corrosion products, and residuals from past fuel rod cutting operations.

In addition, numerous pieces of metal are located in the basins, including a debris object designated SHADO 1, measuring 90 R/hr at contact (EDF-4271); activated metal reading up to 300 R/hr due to mixed fission products; and mixed activation products. The primary contaminant is Cobalt-60. Cobalt-60 decays rapidly with a half-life of 5.27 years. The Cobalt-60 will decay to background radiation levels before the CPP-603 Complex is closed. The CPP-603 is scheduled to operate until 2035. Other items such as fuel buckets, various tools, and disposal containers also are contained in the basins. These objects are contaminated with various radionuclides contained in the sludge.

The scum line is a concentration of contamination at the interface of the water in the basins and the basin walls, rather like the soap scum line in a bathtub. The contamination has penetrated the basins' porous cement walls and has measured at 150 mR/hr beta-gamma. The high activity is currently shielded by the basin water.

2.4 Analytical Data and Basin Inventory

Section 2.4 is taken directly from Engineering Design File (EDF) -4488, "Streamlined Risk Assessment for the CPP-603 EE/CA."

The characterization of contaminants in the CPP-603A Basins has been a topic of interest for some time. In 1993, sludge was sampled from the south basin. In 1994, sludge samples were collected from locations throughout the three basins. Four composite samples were analyzed. The analysis included both radionuclides and nonradionuclides. Analyses for bulk density or particle size distribution were not performed. The results of this sampling and analysis program were used in previous CPP-603A risk assessment analyses (EDF-1962 and EDF-3684).

Laboratory analyses of the 1993 and 1994 samples indicated the presence of silicon, aluminum, and iron as major constituents. The high proportion of silicon and aluminum seems to indicate that a large fraction of the sludge is soil particulate that entered the building because of wind and weather events.

Sample analyses did not indicate the presence of a significant amount of neutron poisons such as boron, cadmium, or chlorine. However, sampling results identified leachable cadmium at concentrations ranging from 1.69 to 8.34 mg/kg. It was estimated that approximately 5.6 kg (12.4 lb) of U-235 was contained in the sludge distributed over the basin floor area (Demmer 1996a, 1996b).

In order to develop a more accurate estimate of the radionuclide inventory in the basins, several studies have been performed in recent years. In particular, sludge samples were taken in late 2002 and water samples were taken in June 2003.

The following sections summarize the potential contaminant sources in the CPP-603A basins and describe the inclusion of the inventory in the EE/CA streamlined risk assessment. The inventory has been divided into the following four waste streams:

- Section 2.4.1—sludge materials on the floor of the basins
- Section 2.4.2—contaminants dissolved in the water
- Section 2.4.3—debris distributed across the basins with particle size greater than 0.125 in. in diameter
- Section 2.4.4—discrete objects significantly larger than 0.125 in. in diameter.

2.4.1 Sludge Materials on the Floor of the Basins

In order to obtain a representative profile for the radionuclides in the basins, samples of CPP-603A sludge were taken in October, November, and December of 2002. The sludge sampling effort was intended to better characterize the readily suspended particulate; therefore, the sampling screened out debris objects (Section 2.4.3) with a diameter greater than 0.125 in.

An EDF entitled "CPP-603 Radionuclide Sample Results" (EDF-4235) contains the estimate of radiological material inventories that currently remain in the sludge in the CPP-603A Basins based on the 2002 sampling (see Table 1), thereby updating earlier estimates (Demmer 1996a). The analysis results represent the solids and water in the sludge.

As discussed in EDF-4235, the concentrations found in the new sludge samples are considerably higher than the concentrations found in the 1994 samples. However, the depth and density of the sludge were shown to be substantially lower than the values assumed for the 1994 analysis. The total inventory of nuclides estimated for the 1994 and 2002 sampling generally are within a factor of two. In particular, based on the 1994 sampling, there is 5.6 kg of U-235 in the basins and based on the 2002 sampling, there is 6.96 kg of U-235 +/- 3.2 kg.

Table 1 lists the nuclide inventories used for this analysis, based on the sludge and water sampling results presented in EDF-4235. Nuclides that were analyzed and had one or no detections out of the 20 sludge samples are noted in the table in bold. These nuclides are assumed to be present in insignificant quantities and are not carried forward in the analysis. The inventories after 500 years of radioactive decay also are shown in Table 1. The decayed inventory is shown, because one of the modeling cases assumes that the CPP-603A facility will be filled with grout and will be essentially impermeable to water for the first 500 years. Note that 13 of the 35 nuclides in Table 1 will essentially decay away in place during the 500 years. In Table 1, the best estimates are used for the sludge inventory, but the uncertainty is conservatively added into the estimated total inventory (also shown in Table 1), which could potentially increase the sludge inventory by about 46%. The estimated total inventory includes other sources as well, as described in Sections 2.4.2–2.4.4.

Since there were no analyses of the nonradionuclides in the 2002 sampling, the sludge inventory from the 1994 sampling is used for this report and was updated to reflect more accurate estimates of sludge volume (EDF-4235). The information was summarized in EDF-1962, "Transport Simulation Approach for the Risk Assessment for Deactivation of INTEC Plant Building CPP-603," and EDF-3684, "Acceptable Residual Inventory Calculations for CPP-603." The inventory for the nonradionuclide contaminants of concern is shown in Table 2.

Table 1. The CPP-603A nuclide inventory based primarily on the 2002 sludge samples and 2003 water samples.

Nuclide	Radioactive Decay Half-life (years)	Sludge and Water Inventory[e]		Estimated Total Inventory[d]	
		Current (Ci)	After 500 years (Ci)	Current (Ci)	After 500 years (Ci)
Ag-108m	**1.27E+02**	**<1.65E-01 (one detection)**	**<1.08E-02**	**<3.30E-01**	**<2.16E-02**
Ag-110m	**6.84E-01**	**<6.70E-01 (nondetect)**	**0**	**<1.34E+00**	**0**
Am-241	4.32E+02	2.25E-02	1.01E-02	4.50E-02	2.02E-02
C-14[f]	5.73E+03	3.13E-04	2.94E-04	6.26E-04	5.88E-04
Ce-144	**7.80E-01**	**<1.87E+00 (nondetect)**	**0**	**<3.74E+00**	**0**
Cm-244	1.81E+01	7.00E-04	3.38E-12	1.40E-03	6.76E-12
Co-58	1.94E-01	1.31E+00	0.00E+00	2.62E+00	0.00E+00
Co-60	5.27E+00	5.66E+01	0	1.13E+02	0
Cs-134	**2.06E+00**	**<4.36E-01 (nondetect)**	**0**	**<8.72E-01**	**0**
Cs-137	3.02E+01	8.70E+01	8.92E-04	1.74E+02	1.78E-03
Eu-152	1.36E+01	2.74E+02	2.34E-09	5.48E+02	4.68E-09
Eu-154	8.80E+00	1.38E+02	1.09E-15	2.76E+02	2.18E-15
Eu-155	4.96E+00	8.91E+00	0	1.78E+01	0
H-3[f]	1.23E+01	9.39E-02	5.83E-14	1.88E-01	1.17E-13
I-129[f]	1.57E+07	7.77E-06	7.77E-06	1.55E-05	1.55E-05
Mn-54	**8.55E-01**	**<4.72E-01 (nondetect)**	**0**	**<9.44E-01**	**0**
Nb-94	**2.03E+04**	**<4.18E-01 (nondetect)**	**<4.11E-01**	**<8.36E-01**	**<8.22E-01**
Nb-95	9.58E-02	7.55E-01	0	1.51E+00	0
Np-237[a]	2.14E+06	5.00E-03[a]	5.00E-03	1.00E-02	1.00E-02
Pu-238	8.77E+01	2.76E-01	5.30E-03	5.52E-01	1.06E-02
Pu-239[b]	2.41E+04	2.01E+00	1.98E+00	4.02E+00	3.96E+00
Pu-240[b]	6.56E+03	2.01E+00	1.91E+00	4.02E+00	3.82E+00
Ra-226	**1.60E+03**	**<6.65E+00 (nondetect)**	**<5.35E+00**	**<1.33E+01**	**<1.07E+01**
Ru-103	**1.07E-01**	**<4.05E-01 (nondetect)**	**0**	**<8.10E-01**	**0**
Ru-106	**1.02E+00**	**<1.01E+00 (nondetect)**	**0**	**<2.02E+00**	**0**
Sb-125	**2.73E+00**	**<3.89E-01 (one detection)**	**0**	**<7.78E-01**	**0**
Sr-90[c]	2.91E+01	2.09E+01	1.41E-04	4.18E+01	2.82E-04
Tc-99[f]	2.13E+05	6.26E-04	6.25E-04	1.25E-03	1.25E-03
Th-228	1.91E+00	1.50E-02	0	3.00E-02	0
U-234	2.45E+05	3.48E-01	3.48E-01	6.96E-01	6.96E-01
U-235	7.04E+08	1.51E-02	1.51E-02	3.02E-02	3.02E-02
U-236	2.34E+07	5.51E-03	5.51E-03	1.10E-02	1.10E-02
U-238	4.47E+09	2.39E-03	2.39E-03	4.78E-03	4.78E-03
Zn-65	**6.68E-01**	**<7.39E+00 (one detection)**	**0**	**<1.48E+01**	**0**
Zr-95	1.75E-01	9.85E+00	0	1.97E+01	0

Table 1. (continued).

Nuclide	Radioactive Decay Half-life (years)	Sludge and Water Inventory[e]		Estimated Total Inventory[d]	
		Current (Ci)	After 500 years (Ci)	Current (Ci)	After 500 years (Ci)

a. In the 2002 sampling, Cm-244, Np-237, and Th-228 were not analyzed. Therefore, the results of the 1994 sampling are used. In the 2002 sampling, "other alpha" is listed as 1.95E-3. This is likely Np-237; however, because it was not specifically analyzed, the more conservative 1994 number was used.
b. The combination of Pu-239 and Pu-240 was reported together under Pu-239. For the purposes of this study, it is conservatively assumed that the reported activity is the activity of each nuclide. The inventory of Pu-239/240 is overestimated by a factor of two, but does not influence the results of the analysis.
c. Strontium was reported as total strontium. It has been assumed that the strontium was all Sr-90. The inventory for nuclides that were not detected or only detected in one out of 20 samples is listed as "less than."
d. As discussed in Section 2.5, the total estimated inventory is assumed to be twice the sludge plus water inventory to incorporate inventory uncertainty and the inventory potentially present in the discrete objects.
e. The sludge analysis included both the solid and the liquid in the sample.
f. The C-14, H-3, I-129, and Tc-99 are generally not sorbed. Therefore, water samples were collected and the inventories shown are based on the activity in the water samples.

Table 2. The CPP-603A nonradionuclide inventory based on the 1994 sampling and analysis of basin sludge.

Contaminant	Initial Estimated Inventory (mg)
Acetone	1.12E+05
Benzene	4.09E+03
Bromomethane	7.99E+02
2-Butanone	1.38E+03
1,2-Dichloroethane	1.26E+03
Methylene chloride	1.26E+03
4-Methyl-2-pentanone	1.32E+03
m- and p-Xylene	2.74E+03
o-Xylene	1.29E+03
Styrene	1.43E+03
Toluene	2.27E+03
Aluminum	1.90E+09
Arsenic	4.15E+03
Barium	1.74E+04
Beryllium	1.40E+04
Cadmium	2.00E+05
Chloride	2.99E+04
Chromium	2.43E+03
Lead	1.49E+04
Mercury	1.36E+01
Nickel	3.35E+03
Selenium	4.12E+03
Silver	3.74E+02
Uranium	4.86E+07
Zinc	3.58E+08

2.4.2 Inventory Dissolved in the Water

For the solids' analyses used to estimate contaminant concentrations in the sludge (Section 2.1), the fusion method was used. In the process, volatile contaminants were lost. Therefore, there was no analysis for C-14, H-3, I-129, and Tc-99 in the sludge analyses. Based on process knowledge, these nuclides are not expected to be present at high concentrations in the CPP-603 Basins. However, since these nuclides are generally contaminants of concern at the INTEC, estimates of their inventory are needed for the streamlined risk assessment.

The C-14, H-3, I-129, and Tc-99 are generally soluble in water and assumed to be leached from the source and move through the environment with essentially no sorption to the soil. This assumption will be verified by analysis of the final waste form for C-14, H-3, I-129, and Tc-99 prior to disposal to confirm compliance with the ICDF waste acceptance criteria. Assuming this is also the case in the CPP-603A Basins, the inventory of C-14, H-3, I-129, and Tc-99 is in the water, not adsorbed in the sludge. In order to get estimates of the C-14, H-3, I-129, and Tc-99 inventory in the CPP-603A Basins, four water samples were collected in the basins and analyzed in June 2003. Since the basins are connected, it was assumed that the concentrations of dissolved constituents are relatively uniform throughout the basin. Analysis results from the data collected are shown in Table 3. Samples were taken from the south basin and the transfer canal. There were a total of four 250-mL samples collected. For C-14, H-3, I-129, and Tc-99, the inventory shown in Table 1 is based on the inventory in the water inferred from the water samples. The table is taken from Appendix B of the CPP-603 radionuclide sampling results presented in EDF-4235.

Table 3. Sample results and total activity estimates from the CPP-603 water samples.

Field Sample ID	Tc-99 (pCi/L)	Uncertainty	H-3 (pCi/L)	Uncertainty	I-129 (pCi/L)	Uncertainty	C-14 (pCi/L)	Uncertainty
CPP-603 Basin SUP1	1.65E+02	5.10E+00	1.65E+04	1.40E+02	1.00E-01	2.30E+00	9.00E+01	4.10E+01
CPP-603 Basin SUP2	1.39E+02	5.00E+00	1.62E+04	1.40E+02	2.40E+00	2.40E+00	*Not detected*	3.90E+01
CPP-603 Basin SUP3	1.20E+02	5.00E+00	1.63E+04	1.40E+02	1.50E+00	2.10E+00	3.90E+01	4.00E+01
CPP-603 Basin SUP4	5.50E+00	4.80E+00	1.55E+04	1.40E+02	*Not detected*	2.60E+00	3.20E+01	3.90E+01
Average pCi/L	1.07E+02	4.98E+00	1.61E+04	1.40E+02	1.33E+00	2.35E+00	5.37E+01	3.98E+01
Standard dev. pCi/L	7.04E+01	—	4.49E+02	—	1.16E+00	—	3.17E+01	—
Basin volume	5.83E+06	Liters	—	—	—	—	—	—
Total pCi	6.26E+08	—	9.39E+10	—	7.77E+06	—	3.13E+08	—
Total Ci	6.26E-04	—	9.39E-02	—	7.77E-06	—	3.13E-04	—

CPP = Chemical Processing Plant
ID = identification

The estimated inventory for C-14, I-129, and Tc-99 is not necessarily conservative, because there could be some inventory in the sludge. However, the results shown in the streamlined risk assessment indicate that the inventory estimated from the water is three to six orders of magnitude less than an inventory of concern. Soluble chemicals (such as carbon, iodine, and technetium) are dissolved primarily in the water, not the solids. Therefore, further sludge analysis for these nuclides is not necessary.

If the basin water is evaporated, the contaminants in the water will precipitate and will remain in the basin. It is possible that there is some relatively small amount of sorption of the C-14, I-129, and Tc-99, but this inventory is assumed to be a small contributor to the overall inventory. The majority of the inventory in the water should be removed from the CPP-603 Basins if the water is removed to the INEEL CERCLA Disposal Facility (ICDF), Process Equipment Waste Evaporator (PEWE), or a comparable facility.

2.4.3 Debris Distributed across the Floor of CPP-603A

Extensive radiological surveying has been conducted throughout the CPP-603A building. The results of the survey are documented in EDF-3535, "CPP-603 Basins—Fissile Material in Particulate Form based on ^{137}Cs to ^{235}U Ratio." Basin floor surveys of the north basin detected levels ranging from 100 to 900 mR/hr, basin floor surveys of the middle basin detected levels ranging from 100 mR/hr to 10.2 R/hr near the southeast corner, and basin floor surveys of the south basin detected radiation levels from 100 to 600 mR/hr. A floor survey of the transfer canal detected radiation levels from 100 mR/hr to 32 R/hr near the south end of the canal. Generally, radiation readings from the basins are approximately 5 to 15 mR/hr on the top of the basin and 100 to 150 mR/hr at the scum ring around the basin walls.

In order to estimate the U-235 inventory in the debris, the scanning results were used to calculate the presence of Cs-137 and then to infer from these measurements the mass of U-235. By estimating the mass of U-235, the inventory of the debris can be compared to the inventory in the sludge. As explained in Section 2.4.1, based on the 2002 sampling, the sludge contains 7.0 +/- 3.2 kg of U-235 or a conservative estimate of 10.2 kg. Based on the radiological surveying, the debris contains approximately 3.8 kg of U-235. Therefore, the debris inventory is assumed to be approximately 55% of the best estimate of the U-235 sludge inventory or 38% of the conservative estimate. For purposes of the streamlined risk assessment, it is assumed that the nuclide composition of the debris is the same as the nuclide composition of the sludge, and the inventory is increased accordingly.

2.4.4 Discrete Objects

Discrete objects were identified using spectrometry data from survey of objects found in the basin to estimate the total activity from discrete objects significantly greater than 0.125 in. in diameter. Fourteen discrete objects were identified, 13 are non-uranium-bearing metal objects (end boxes, etc.) with Cobalt-60 contamination and one is a small high-activity uranium-bearing object (SHADO). The discrete objects are described in detail in EDF-4271, "Quantification of Three Debris Objects from the South Basin of CPP-603 Using the Underwater Gamma Spectrometer System (TUGS)."

The activated metals are not expected to contain any of the contaminants of concern for this streamlined risk assessment. However, the SHADO would be similar in makeup to both the contaminants in the sludge and in the debris. The SHADO is estimated to contain approximately 3 g of U-235, which is 0.04% of the estimated U-235 inventory. This is an insignificant contributor to the overall nuclide inventory in the CPP-603 Basins.

2.4.5 Basin Inventory Summary and Discussion

As discussed in the subsections above, nuclide-specific inventories at the CPP-603A Basins are available for the sludge and for C-14, H-3, I-129, and Tc-99 in the water. Details on the nuclide-specific inventories can be found in EDF-4235. For debris over 0.125 in. in diameter (EDF-3535), which is distributed throughout the basins and larger discrete objects (EDF-4271), estimates of the U-235 mass have been inferred based on radiological surveys that measure for Cs-137.

An estimated total inventory is needed for the streamlined risk assessment. For purposes of this estimate, it is assumed that the nuclide-specific inventory from the sludge and water samples has the same nuclide composition as the debris and discrete objects of interest. Since estimates are available for the U-235 mass of each waste stream, the nuclide-specific inventory is scaled up based on the relative U-235 mass to provide an estimate of the nuclide-specific total inventory.

As discussed in the previous subsections, the sludge is estimated to contain 6.96 +/- 3.22 kg of U-235, the debris is estimated to contain 3.8 kg of U-235, and the discrete objects are estimated to contain 0.003 kg of U-235. For this report, it is assumed that the total amount of U-235 is $6.96+3.22+3.8+0.003$ or approximately 14 kg of U-235. This is twice the estimated inventory of U-235 in the sludge. Therefore, the estimated total inventory is assumed to be twice the inventory in the sludge and water samples as shown in Table 1.

As discussed in Section 2.4.1, there were no analyses of the nonradionuclides in the 2002 sampling. The sludge inventory from the 1994 sampling was used for this report and was updated to reflect more accurate estimates of sludge volume (EDF-4235). The inventory for the nonradionuclide contaminants of concern is shown in Table 2.

2.5 Streamlined Risk Assessment

Groundwater risk analysis was performed to support evaluation of alternatives for decommissioning the CPP-603A Basins. Additional details of the CPP-603 streamlined risk assessment are included in EDF-4488, "Streamlined Pathway Risk Assessment for the CPP-603 EE/CA." This section is taken directly from that document. This streamlined risk assessment uses methodologies that are consistent with those used to support the *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999).

A conservative evaluation of the potential contribution from contaminated soil near CPP-603A has been documented in EDF-4489, "Soil Contamination Groundwater Pathway Risk Assessment for CPP-603 Engineering Evaluation/Cost Analysis." This EDF documents a screening-level evaluation of the soil contamination for soil in the vicinity of the CPP-603A Basins. Since these nonradionuclide concentrations were at background levels, the screening-level evaluation did not perform additional calculations for these constituents. No other surface exposure pathways exist from CPP-603A, since the sludge and debris are present 20 ft below ground, the water will be removed, and the basins will be filled with an inert material. Consistent with the *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999), surface pathway risks are assumed to occur for contamination from ground surface to 10 ft below ground surface.

The "Soil Contamination Groundwater Pathway Risk Assessment for CPP-603 Engineering Evaluation/Cost Analysis" (EDF-4489) does not include an evaluation of a potential release from Drain Line 3-1/2" PLA-100115, which is associated with the south decontamination pad, located adjacent to the CPP-603A south fuel storage basin. This drain line failed integrity tests and was flushed to eliminate risk of future releases to the environment. Soil under this drain line has not been characterized because of concern that drilling, boring, or sampling might jeopardize the integrity of the basin walls. Consequently, characterization of this potential soil release site cannot occur until after the basin water has been removed. The soil under this drain line and all soil associated with the basins will be characterized when the entire CPP-603 Complex is decommissioned. For the purposes of this analysis, it is assumed that this potential release site poses insignificant risk to groundwater relative to the source term in the basin. The remainder of this section discusses contamination within the CPP-603A Basins.

2.5.1 CPP-603A Radionuclide Contaminant Screening

The radionuclides that were detected in more than one of the 20 sludge samples were screened to a set of contaminants of concern using the National Council on Radiation Protection (NCRP) screening factors (NCRP 1996). The assumed intact life span of the grouted CPP-603A Basins after final disposition is assumed to be 500 years. This assumption is based on similar assumptions in the *Idaho High-Level Waste & Facilities Disposition Final Environmental Impact Statement* (DOE-ID 2002). Complete failure is assumed at the end of the intact life span. Water will then move through the grouted waste material at the same rate it would move through native soil. Therefore, the radionuclide inventory screening uses the inventory after 500 years of radioactive decay.

As shown in Table 4, the nuclide inventories in the sludge were decayed for 500 years and then multiplied by the NCRP factors to give a measure of the expected contribution of each nuclide to the total dose. The screening criterion chosen is that any nuclide that contributes more than 1/1,000th (0.1%) to the total dose was retained as a contaminant of concern. However, as can be seen in Table 4, a number of mobile nuclides that are contaminants of interest at the INTEC would be screened at that level (C-14, I-129, and Tc-99). Since C-14, I-129, and Tc-99 are contaminants of general interest at the INTEC, they were included as contaminants of concern even though they failed the NCRP screening.

The 11 radionuclides defined as contaminants of potential concern (COPCs) are in bold type and highlighted in yellow or blue in Table 4. The eight COPCs highlighted in yellow contribute over 99.8% of the total product. Of these, Pu-239 and Pu-240 contribute almost 90% of the total dose. In addition to the primary dose contributors, C-14, I-129, and Tc-99 are highlighted in blue and included as COPCs, because they have been identified as significant contaminants of concern in the aquifer at INTEC in related projects. Therefore, more detailed analysis was warranted.

Based on the screening dose factors, Pu-239 and Pu-240 appear to be the primary risk drivers. However, this screening does not take into account the effects of different transport times through the vadose zone for retarded contaminants and the ultimate impact on the predicted groundwater concentrations. For this reason, the potential contaminants of concern must be reevaluated with contaminant transport simulations.

2.5.2 Modeling Approach and Assumptions

For this streamlined risk assessment, two cases are evaluated: (1) a base case, which assumes that the basins are simply filled with soil and (2) a grouted source scenario. **In each case, the sludge and debris are assumed to remain in the CPP-603A Basins.** This is a worst case than the preferred alternative. The two cases evaluated represent worst-case scenarios with respect to inventory in the basins and, therefore, bound the analysis. Any source removal prior to closure would decrease the predicted risk.

The basic conceptual model and associated parameters chosen for the CPP-603A model are consistent with the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003). A unit mass or activity of each contaminant is used to calculate the resulting unit concentration at a receptor location. The predicted aquifer concentration is calculated by multiplying the unit concentration by the inventory. This concentration is then compared with a limiting concentration

Table 4. Radionuclide screening using the National Council on Radiation Protection screening dose factors.

Nuclide	Radioactive Decay Rate	Current Inventory	Sludge[a] and Water Activity in 500 years		Screening Factor (Table 3-2 in NCRP 1996)	Inventory in 500 years (Bq) Times the NCRP Screening Factor[b]	% Dose
	(years)	(Ci)	(Ci)	(Bq)	Sv/Bq	Sv	
Am-241	**4.32E+02**	**2.25E-02**	**1.01E-02**	**3.74E+08**	**8.40E-12**	**3.14E-03**	**0.21%**
C-14	**5.73E+03**	**3.13E-04**	**2.94E-04**	**1.09E+07**	**1.70E-11**	**1.85E-04**	**0.01%**
Cm-244	1.81E+01	7.00E-04	3.38E-12	1.25E-01	3.00E-12	3.76E-13	0.00%
Co-58	1.94E-01	1.31E+00	0.00E+00	0.00E+00	6.90E-18	0.00E+00	0.00%
Co-60	5.27E+00	5.66E+01	1.56E-27	5.76E-17	6.60E-12	3.80E-28	0.00%
Cs-137	3.02E+01	8.70E+01	8.92E-04	3.30E+07	1.40E-11	4.62E-04	0.03%
Eu-152	1.36E+01	2.74E+02	2.34E-09	8.67E+01	6.60E-12	5.72E-10	0.00%
Eu-154	8.80E+00	1.38E+02	1.09E-15	4.02E-05	5.40E-12	2.17E-16	0.00%
Eu-155	4.96E+00	8.91E+00	4.02E-30	1.49E-19	1.70E-13	2.53E-32	0.00%
H-3	1.23E+01	9.39E-02	5.83E-14	2.16E-03	3.10E-13	6.68E-16	0.00%
I-129	**1.57E+07**	**7.77E-06**	**7.77E-06**	**2.87E+05**	**2.00E-10**	**5.75E-05**	**0.00%**
Nb-95	9.58E-02	7.55E-01	0.00E+00	0.00E+00	7.00E-22	0.00E+00	0.00%
Np-237	**2.14E+06**	**5.00E-03**	**5.00E-03**	**1.85E+08**	**3.00E-10**	**5.55E-02**	**3.64%**
Pu-238	**8.77E+01**	**2.76E-01**	**5.30E-03**	**1.96E+08**	**7.90E-12**	**1.55E-03**	**0.10%**
Pu-239	**2.41E+04**	**2.01E+00**	**1.98E+00**	**7.33E+10**	**9.50E-12**	**6.96E-01**	**45.74%**
Pu-240	**6.56E+03**	**2.01E+00**	**1.91E+00**	**7.05E+10**	**9.40E-12**	**6.63E-01**	**43.55%**
Sr-90	2.91E+01	2.09E+01	1.41E-04	5.20E+06	3.60E-11	1.87E-04	0.01%
Tc-99	**2.13E+05**	**6.26E-04**	**6.25E-04**	**2.31E+07**	**1.30E-11**	**3.00E-04**	**0.02%**
Th-228	1.91E+00	1.50E-02	2.36E-81	8.72E-71	7.10E-13	6.19E-83	0.00%
U-234	**2.45E+05**	**3.48E-01**	**3.48E-01**	**1.29E+10**	**5.80E-12**	**7.46E-02**	**4.90%**
U-235	**7.04E+08**	**1.51E-02**	**1.51E-02**	**5.57E+08**	**2.00E-11**	**1.11E-02**	**0.73%**
U-236	2.34E+07	5.51E-03	5.51E-03	2.04E+08	4.70E-12	9.57E-04	0.06%
U-238	**4.47E+09**	**2.39E-03**	**2.39E-03**	**8.86E+07**	**1.70E-10**	**1.51E-02**	**0.99%**
Zr-95	1.75E-01	9.85E+00	0.00E+00	0.00E+00	8.80E-19	0.00E+00	0.00%

a. Screening is based on the sludge and water inventory in 500 years rather than the total inventory. The total inventory is estimated to be twice the sludge plus water inventory to account for uncertainty and debris in the basins. Since the screening is based on percent contribution, the screening is the same for the sludge inventory as for the entire inventory.
b. Note that 1 mrem equals 1×10^{-5} Sv.
NCRP = National Council on Radiation Protection

calculated based on a cancer risk of 10^{-4} or 10^{-6} and the maximum contaminant level (MCL). Using this information, an allowable residual contamination (ARC) inventory for each contaminant is calculated and compared with the projected inventory in the CPP-603A facility. In addition, the predicted risk is calculated for each contaminant.

The following assumptions were made for the analysis:

- The groundwater pathway is assumed to be the only significant contaminant exposure pathway.
- This evaluation assumes that the current estimated inventory in the CPP-603A facility would be left in place.
- Contaminant diffusion will be negligible from the soil or the grout used to stabilize the source.

- The sludge left in the basins after deactivation is about half the total inventory used for this streamlined risk assessment. Debris and the uncertainty in the sludge inventory are assumed to make up the other half.

- The source thickness is 0.6 m (2 ft), which is the estimated thickness of the contaminated sludge that either will be mixed with soil (base case) or grout (grouted source case) during decontamination and grouting. Either clean soil or grout will be located above the contaminated portion of the grout to isolate the contaminated grout from the ground surface.

- Water and contaminants move straight down through the vadose zone sediments. The contaminant velocity through the sediments depends on the contaminant-specific sediment Kd. There is no retardation effect from the basalt and there is no horizontal spreading in the vadose zone. Based on the results of the calibration to the remedial investigation/baseline risk assessment (RI/BRA) model (DOE-ID 1997a), the absence of lateral spreading is a conservative assumption.

- The contaminant solubility is conservatively assumed to be infinite for these analyses. If a contaminant appears to pose a significant risk to the groundwater quality, then a reasonable solubility limit could be identified and later incorporated into the analysis.

- The ARC inventories for radionuclides are calculated based on limiting aquifer concentrations corresponding to a 10^{-4} and 10^{-6} risk.

- The ARC inventories for nonradionuclides are calculated based on limiting aquifer concentrations corresponding to a risk of 10^{-6} or a maximum contaminant level.

- The receptor is assumed to be 100 m downgradient from the edge of the CPP-603A facility.

- The ARC inventories are based on a predicted peak aquifer concentration regardless of the time of peak. In some cases, the ARC inventory would be much lower if the timeframe of interest was reduced to 1,000 or 10,000 years.

- The ARC inventory for Am-241 is the activity equivalent of the ARC inventory calculated for Np-237. This assumption was made, because Am-241 decays relatively quickly to Np-237 and the Am-241 is basically immobile in comparison with Np-237. Therefore, this conservative assumption is equivalent to assuming that the Am-241 decays immediately to Np-237.

- The ARC inventory for Pu-238 is the activity equivalent of the ARC inventory calculated for U-234. This assumption was made, because Pu-238 decays relatively quickly to U-234 and Pu-238 is basically immobile in comparison with U-234. Therefore, this conservative assumption is equivalent to assuming that the Pu-238 decays immediately to U-234.

- The *GWSCREEN: A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination: Version 2.0 Theory and User's Manual* (Rood 1999) is used for the source release and contaminant transport simulations.

As discussed above, there are two risk assessment cases evaluated. The following are assumptions that vary based on whether the CPP-603A Basins will be filled with soil or grout:

- If the basins are filled with soil, water is assumed to move through the contaminated soil at a background infiltration rate of 1 cm/yr. If an infiltration-reducing cover such as the proposed ICDF cover is place over CPP-603A, this infiltration rate will be reduced as will the predicted risk.

- If the basins are filled with grouted, the contaminants will be immobilized for 500 years. At 500 years, the grouted basins will instantaneously fail and water will be able to move through the basins.

- After failure of the grouted source, water will move through the grout at a rate of 1 cm/yr, which is equal to the estimated infiltration rate through undisturbed soil at the INEEL. This assumption corresponds to an earthen cover that reduces infiltration to the background rates.

Since the two risk assessment scenarios evaluated include one where the contaminants are available to be leached from the basins immediately after closure if the basins are filled with soil and after 500 years if the basins are filled with grout, nuclide predictions are compared to current inventories for the soil scenarios and inventories with 500 years of radioactive decay for the grout scenarios.

The conceptual model used for the analysis is shown in Figure 4. The parameter values used in the GWSCREEN simulations that are not contaminant specific are shown in Table 5. The contaminant-specific parameter values are shown in Table 6 for the nonradionuclides and Table 7 for the radionuclides.

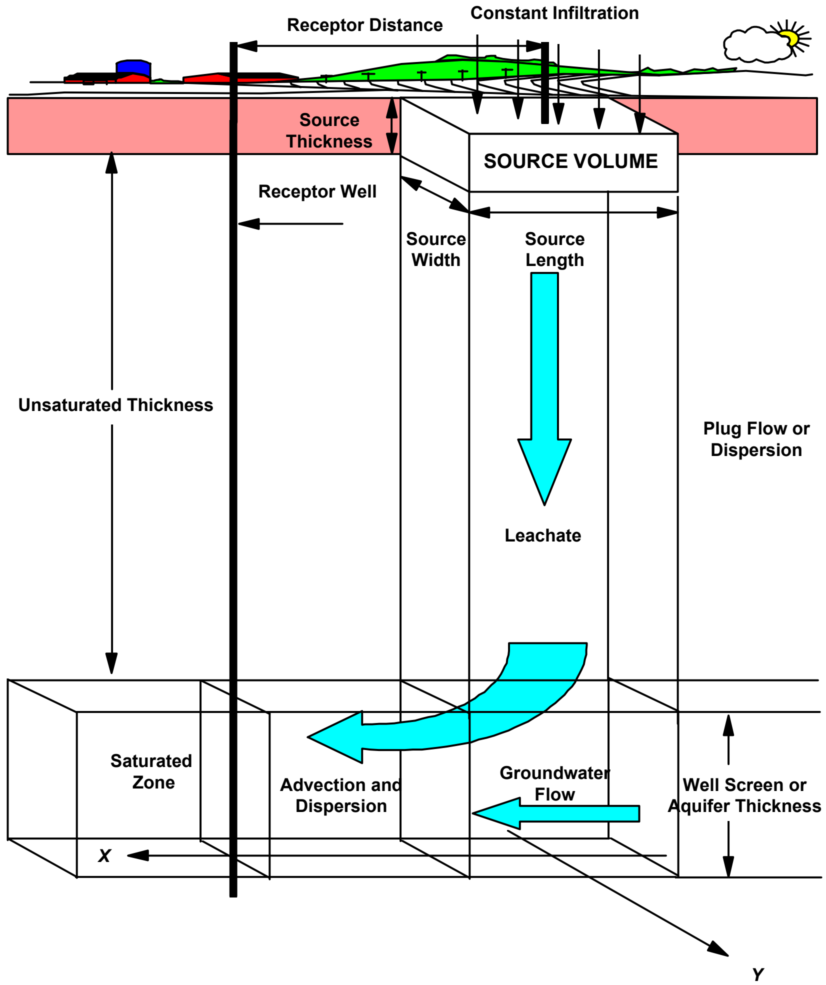

Figure 4. Conceptual model of GWSCREEN for the source volume, unsaturated zone, and aquifer (Rood 1999).

Table 5. Constant parameter values used in the CPP-603A GWSCREEN simulations.

Parameter	Values	Values	Source of Parameter Values
Source			
Length (CPP-603)	42.9 m	140.7 ft	CPP-603A design (EDF-3684)
Width (CPP-603)	21.4 m	70.2 ft	CPP-603A design (EDF-3684)
Thickness (CPP-603)	0.6 m	2 ft	CPP-603A design (EDF-3684)
Bulk density	1.5 g/cm^3		Composite Analysis (DOE-ID 2003)
Moisture content	0.3 %		RI/BRA (DOE-ID 1997a)
Infiltration rate			
0–500 years	0 m/y	0 in/y	Composite Analysis (DOE-ID 2003)
500 years and after	0.01 m/y	0.4 in/y	Composite Analysis (DOE-ID 2003)
Unsaturated Zone			
Thickness (cumulative interbeds)	22.7 m	74.5 ft	Composite Analysis (DOE-ID 2003)
Longitudinal dispersivity	2.92 m	9.6 ft	Composite Analysis (DOE-ID 2003)
Bulk density	1.36 g/cm^3		Composite Analysis (DOE-ID 2003)
Moisture content[a]	0.285 %		Calculated in GWSCREEN
Aquifer			
Thickness	76 m	250 ft	Composite Analysis (DOE-ID 2003)
Well screen thickness	15 m	49.2 ft	Track 2 Guidance Document (DOE-ID 1994)
Darcy velocity	21.9 m/y	71.85 ft/y	Composite Analysis (DOE-ID 2003)
Average linear velocity	365 m/y	1,200 ft/y	Calculated
Porosity	0.06		Composite Analysis (DOE-ID 2003)
Bulk density	2.49 g/cm^3		Composite Analysis (DOE-ID 2003)
Variable longitudinal dispersivity[b]	4.9 m	16 ft	Calculated in GWSCREEN at 100 m from CPP-603
Ratio transverse/longitudinal	0.2		Composite Analysis (DOE-ID 2003)
Ratio vertical/longitudinal	0.00116		Composite Analysis (DOE-ID 2003)
Receptor Distance from the Center of the Source			
x (along flow direction)	121.45 m	398 ft	100 m downgradient of CPP-603
y (perpendicular to flow direction)	0 m	0 ft	Along the line of maximum concentration
Receptor Scenario			
Drinking water ingestion rate	2 L/day		
Exposure frequency	350 d/yr		
Exposure duration	30 yr		
Averaging time	70 years = 25,550 days		

a. Characteristic curve in the vadose zone uses the van Genuchten formulation to calculate the moisture content (Rood 1999). The parameter values used are:

- Residual moisture content = 0.142
- Saturated moisture content = 0.487
- Saturated hydraulic conductivity (m/y) = 21.13.

a = fitting parameter (1/m) = 1.066

n = fitting parameter = 1.523

b. Longitudinal dispersivity is defined as $1.20(\log_{10} L)^{2.958}$ where L = 121.45 m (Rood 1999, Section 2.3).

CPP = Chemical Processing Plant
DOE-ID = U.S. Department of Energy Idaho Operations Office
EDF = engineering design file
RI/BRA = remedial investigation/baseline risk assessment

Table 6. Nonradionuclide contaminant-specific parameter values used in the CPP-603A analysis.

COPCs	Reference Dose or Slope Factor: RfD (mg/kg/d) or SF $(mg/kg/d)^{-1}$	Hazard or Risk-based Limiting Concentration[e] (mg/L)	CPP-603A Inventory[a] (mg)	Soil-Water Partition Coefficient: Soil (mL/g)	Aquifer Basalt (mL/g)	Concrete (mL/g)
Acetone	1.00E-01	3.56E+00	1.12E+05	0	0	0[d]
Benzene	2.90E-2(SF)	2.93E-03	4.09E+03	0.2	0.008	0.2[d]
Bromomethane	1.40E-03	5.11E-02	7.99E+02	NA	NA	NA
2-Butanone	6.00E-01	2.19E+01	1.38E+03	NA	NA	NA
1,1-Dichloroethene	NA	7E-03(MCL)	1.26E+03	0.19	0.0076	0.19[d]
Methylene chloride	7.50E-3(SF)	1.13E-02	1.26E+03	0.026	0.00104	0.026[d]
4-Methyl-2-pentanone	NA	NA	1.32E+03	NA	NA	NA
m- and p-Xylene	2.00E+00	7.30E+01	2.74E+03	3	0.12	3[d]
o-Xylene	2.00E+00	7.30E+01	1.29E+03	NA	NA	NA
Styrene	2.00E-01	7.30E+00	1.43E+03	NA	NA	NA
Toluene	2.00E-01	7.30E+00	2.27E+03	1	0.04	1[d]
Aluminum	1.00E+00	3.65E+01	1.90E+09	250	10	250[d]
Arsenic	1.50E+0(SF)	5.67E-05	4.15E+03	3	0.12	3[d]
Barium	7.00E-02	2.56E+00	1.74E+04	50	2	50[d]
Beryllium	4.30E+0(SF)	1.98E-05	1.40E+04	250	10.	250[d]
Cadmium	1.00E-03	3.65E-02	2.00E+05	6	0.24	23[b]
Chloride	NA	2.5E+2(MCL)	2.99E+04	0	0	1[c]
Chromium	5.00E-03	1.83E-01	2.43E+03	1.2	0.048	1.2[d]
Lead	NA	1.5E-2(MCL)	1.49E+04	100	4	100[d]
Mercury	1.00E-04	3.65E-03	1.36E+01	100	4	60[b]
Nickel	2.00E-02	7.30E-01	3.35E+03	100	4	100[c]
Selenium	5.00E-03	1.83E-01	4.12E+03	4	0.16	4[d]
Silver	5.00E-03	1.83E-01	3.74E+02	90	3.6	90[d]
Uranium	3.00E-03	1.10E-01	4.86E+07	6	0.24	2,000[b]
Zinc	3.00E-01	1.10E+01	3.58E+08	16	0.64	16[d]

a. From 1994 laboratory data supporting Demmer (1996a), "Basin Sludge Calculations for CPP-603 Fuel Basins"
b. From the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003)
c. From the *Effects of Radionuclide Concentrations by Cement/Ground-water Interactions in Support of Performance Assessment of Low-Level Radioactive Waste Disposal Facilities* (Krupka and Serne 1998), Table 5-1
d. No concrete Kd information is available. The soil Kd value was used.
e. The hazard- and risk-based limiting concentrations are calculated based on the reference dose or slope factor and exposure parameters. The exposure parameters are listed in Table 4-1 of EDF-4488.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = *Code of Federal Regulations*
COPC = contaminant of potential concern
CPP = Chemical Processing Plant
INEEL = Idaho National Engineering and Environmental Laboratory
MCL = maximum contaminant level—maximum drinking water concentration limit is based on 40 CFR 141.61, "Maximum Contaminant Levels for Organic Contaminants."
NA = not available—assume Kd = 0 for the soil and aquifer basalt.
OU = operable unit
RfD = reference dose
RI/BRA = remedial investigation/baseline risk assessment
RI/FS = remedial investigation/feasibility study
SF = Limiting concentration is based on a slope factor. The others are based on a reference dose. The slope factors are taken from the tables in the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997a) in order to be consistent.

Table 7. Radionuclide contaminant-specific-parameter values used in the GWSCREEN analysis.

COPCs Parent Progeny	Radioactive Half-life (years)	Slope Factor[b] (1/pCi)	10^{-6} Risk-based Water Conc.[c] (pCi/L)	CPP-603A Inventory: Current Estimate (Ci)	CPP-603A Inventory: Estimate after 500 years of Decay (Ci)	Soil-Water Partition Coefficient (Kd)[a]: Soil (mL/g)	Soil-Water Partition Coefficient (Kd)[a]: Aquifer (mL/g)	Soil-Water Partition Coefficient (Kd)[a]: Concrete (mL/g)
Am-241	432	3.28E-10	1.46E-01	4.50E-02	2.02E-02	340	13.6	5,000
Np-237	2.14E+06	3.00E-10	1.60E-01	—	—	8	0.32	—
U-233	1.59E+05	4.48E-11	1.07E+00	—	—	6	0.24	—
Th-229	7,340	3.56E-10	1.35E-01	—	—	100	4	—
C-14	5.73E+03	1.03E-12	4.62E+01	6.26E-04	5.88E-04	0.1	0.004	10
I-129	1.57E+07	1.84E-10	2.59E-01	1.55E-05	1.55E-05	0.1	0.004	2
Np-237	2.14E+06	3.00E-10	1.60E-01	1.00E-02	1.00E-02	8	0.32	5,000
U-233	1.59E+05	4.48E-11	1.07E+00	—	—	6	0.24	—
Th-229	7,340	3.56E-10	1.35E-01	—	—	100	4	—
Pu-238	87.8	2.95E-10	1.63E-01	5.52E-01	1.06E-02	140	5.6	5,000
U-234	2.45E+05	4.44E-11	1.08E+00	—	—	6	0.24	—
Th-230	7.54E+04	3.75E-11	1.28E+00	—	—	100	4	—
Ra-226	1,600	2.96E-10	1.62E-01	—	—	100	4	—
Pb-210	22.3	1.01E-09	4.75E-02	—	—	100	4	—
Pu-239	2.41E+04	3.16E-10	1.52E-01	4.02E+00	3.96E+00	140	5.6	5,000
U-235	7.04E+08	4.70E-11	1.02E+00	—	—	6	0.24	—
Pa-231	3.28E+04	1.49E-10	3.19E-01	—	—	550	22	—
Ac-227	21.8	6.26E-10	7.60E-02	—	—	450	18	—
Pu-240	6.56E+03	3.15E-10	1.51E-01	4.02E+00	3.96E+00	140	5.6	5,000
U-236	2.34E+07	4.21E-11	1.13E+00	—	—	6	0.24	—
Th-232	1.41E+10	3.28E-11	1.45E+00	—	—	100	4	—
Ra-228	5.75	2.48E-10	1.92E-01	—	—	100	4	—
Pb-210	1.91	2.31E-10	2.06E-01	—	—	100	4	—
Tc-99	2.11E+05	1.40E-12	3.40E+01	1.25E-03	1.25E-03	0.2	0.008	1,000
U-234	2.45E+05	4.44E-11	1.08E+00	6.96E-01	6.96E-01	6	0.24	2,000
Th-230	7.54E+04	3.75E-11	1.28E+00	—	—	100	4	—
Ra-226	1,600	2.96E-10	1.62E-01	—	—	100	4	—
Pb-210	22.3	1.01E-09	4.75E-02	—	—	100	4	—
U-235	7.04E+08	4.70E-11	1.02E+00	3.02E-02	3.02E-02	6	0.24	2,000
Pa-231	3.28E+04	1.49E-10	3.19E-01	—	—	550	22	—
Ac-227	21.8	6.26E-10	7.60E-02	—	—	450	18	—
U-238	4.47E+09	6.20E-11	7.68E-01	4.78E-03	4.78E-03	6	0.24	2,000
U-234	2.45E+05	4.44E-11	1.08E+00	—	—	6	0.24	—
Th-230	7.54E+04	3.75E-11	1.28E+00	—	—	100	4	—
Ra-226	1,600	2.96E-10	1.62E-01	—	—	100	4	—
Pb-210	22.3	1.01E-09	4.75E-02	—	—	100	4	—

Note: Progeny ingrowth was ignored for the first 500 years.

a. From the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003)

b. Slope factors were taken from the tables in the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997a) in order to be consistent.

c. The risk-based concentrations are calculated based on the slope factor and exposure parameters.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
COPC = contaminant of potential concern
CPP = Chemical Processing Plant
DOE-ID = U.S. Department of Energy Idaho Operations Office
INEEL = Idaho National Engineering and Environmental Laboratory
OU = operable unit
RI/BRA = remedial investigation/baseline risk assessment
RI/FS = remedial investigation/feasibility study

Listed below are the major contaminant-specific assumptions:

- The contaminant-specific partition coefficient (Kd) values are consistent with those used in the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003), which are based primarily on Track 2 default values (DOE-ID 1994), and those used in the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997a). In general, these are conservative screening-level values, where:
  - For chemicals where no Kd could be found, a conservative value of 0 mL/g was assumed.
  - For chemicals for which no concrete Kd values are available, soil Kd values were used. This assumes there is no grouting, but the CPP-603A Basins are simply filled with soil.
  - In the vadose zone sediments, Kd values are taken from the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003) modeling.
  - In the *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final)* (DOE-ID 1997a), it was assumed that the aquifer basalt Kd values are 25 times smaller than the assumed soil Kd values. The same assumption was used in the *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill* (DOE-ID 2003) and this evaluation.
- Radionuclide progeny were included in the analysis. The progeny are assumed to move with the parent in the GWSCREEN simulations.

2.5.3 CPP-603A Results

Tables 8, 9, and 10 show the model predictions, calculated ARC inventories, and comparison with the current estimated inventory and the nuclide inventory projected after 500 years of radioactive decay and the predicted risk. Table 8 shows the nonradionuclide results, and Tables 9 and 10 show the radionuclide results assuming a soil source in Table 9 and grouted source in Table 10. As discussed previously, a baseline calculation was done for both the nonradionuclides and the radionuclides, making the assumption that the basins are filled with soil (rather than grout) and the ARC inventory as well as the risk are calculated for the CPP-603A Basins.

In the case of the nonradionuclides, the analysis shows all the contaminants that are predicted to be transported into the aquifer and result in aquifer concentrations below the MCL and at risk less than 10^{-6} (Table 8). The maximum predicted risk is 10^{-10}. Therefore, based on the nonradionuclide analysis, there is no need to grout the CPP-603A Basins.

For the radionuclides, when soil is used to fill the basins (Table 9), the analysis predicts that U-234 will be transported to the aquifer, resulting in aquifer concentrations that are approximately 2×10^{-6} risk-based U-234 concentration (50 times less than the 10^{-4} risk level). Therefore, the radionuclides are reevaluated using source-term Kd values that are appropriate for a grouted source (Table 10). Note that for the grouted source scenario, it is assumed that no water infiltrates through the facility for 500 years, so the assumed inventory is the current inventory decayed for 500 years. Assuming a grouted source, the predicted U-234 aquifer risk is 2.2×10^{-7} or a factor of 4.5 below the 10^{-6} risk-based U-234 concentration and a factor of 450 below the 10^{-4} risk-based U-234 concentration.

Americium-241 and Pu-238 are nuclides that are strongly sorbed but decay relatively quickly to more mobile contaminants (Np-237 and U-234). Therefore, exposure and risk in the aquifer from Am-241 and Pu-238 would come from the Np-237 and U-234 progeny. In Tables 9 and 10, the Am-241 and Pu-238 ARC inventories are the activity equivalent of the ARC inventories calculated for Np-237 and U-234, respectively. In addition, in the CPP-603A inventory columns, Np-237 and U-234 inventories are listed under the Am-241 and Pu-238 inventories, because the Am-241 and Pu-238 inventories after 500 years are misleading with respect to the model assumptions and results. Since Am-241 and Pu-238 are assumed to exist completely as Np-237 and U-234, there are essentially no differences between the current inventory and the inventory in 500 years.

The C-14, I-129, and Tc-99 inventories were based solely on water samples and are not conservative if there is inventory adsorbed to the sludge or in the debris or discrete objects. As can be seen in Tables 9 and 10, the estimated inventories are a factor of three to six orders of magnitude less than the ARC inventory and thousands of times less than the C-14 and Tc-99 inventories. Even if the C-14, I-129, and Tc-99 are somewhat underestimated, the inventories are still well below the ARC inventories.

Based on this streamlined risk assessment, filling the basins and canals with soil or grout, while leaving all current source inventory in place, results in predicted groundwater concentrations that meet the required performance criteria. For groundwater, the performance criterion is to prevent migration of contaminants from the CPP-603A Basins that would cause the Snake River Plain Aquifer (located outside the INTEC security fence) to exceed a cumulative carcinogenic risk level of 1×10^{-4}, a total hazard index of one, or applicable State of Idaho groundwater quality standards in 2095 and beyond. Note that the contribution to risk is sufficiently below the 10^{-4} risk standard (at least a factor of 55 if filled with soil and 450 if filled with grout) so that based on this analysis, CPP-603 is not a significant contributor to cumulative risk.

Table 8. Nonradionuclide allowable residual contamination inventories and comparison with projected residual inventory assuming a soil source term.

	10^{-6} Risk-based Limiting Concentration	MCL	Predicted from Unit Inventory Times Inventory		ARC Inventory			Predicted Risk
			Time of Peak Concentration	Predicted Peak Concentration	Based on Limiting Concentration	Based on MCL	Estimated CPP-603A Inventory (Table 2-2)	
	(mg/m^3)	(mg/m^3)	(years)	(mg/m^3)	(mg)	(mg)	(mg)	
Acetone	3.56E+03	NA	5.13E+02	7.90E-03	5.05E+10	NA	1.12E+05	2.22E-12
Benzene	2.93E+00	5.00E+00	1.00E+03	1.48E-04	8.12E+07	1.39E+08	4.09E+03	5.04E-11
Bromomethane	5.11E+01	NA	5.13E+02	5.63E-05	7.25E+08	NA	7.99E+02	1.10E-12
2-Butanone	2.19E+04	NA	5.13E+02	9.73E-05	3.11E+11	NA	1.38E+03	4.44E-15
1,1-Dichloroethene	7.00E+00	7.00E+00	9.78E+02	4.66E-05	1.89E+08	1.89E+08	1.26E+03	6.66E-12
Methylene chloride	1.13E+01	NA	5.76E+02	7.90E-05	1.80E+08	NA	1.26E+03	6.99E-12
4-Methyl-2-pentanone	NA	NA	5.13E+02	9.31E-05	NA	NA	1.32E+03	NA
m- and p-Xylene	7.30E+04	1.00E+04	7.86E+03	1.26E-05	1.59E+13	2.17E+12	2.74E+03	1.73E-16
o-Xylene	7.30E+04	1.00E+02	5.13E+02	9.09E-05	1.04E+12	1.42E+09	1.29E+03	1.25E-15
Styrene	7.30E+03	1.00E+03	5.13E+02	1.01E-04	1.04E+11	1.42E+10	1.43E+03	1.38E-14
Toluene	7.30E+03	1.00E+04	2.96E+03	2.77E-05	5.97E+11	8.18E+11	2.27E+03	3.79E-15
Aluminum	3.65E+04	2.00E+02	6.13E+05	1.12E-01	6.18E+14	3.39E+12	1.90E+09	3.08E-12
Arsenic	5.67E-02	5.00E+01	7.86E+03	1.91E-05	1.23E+07	1.09E+10	4.15E+03	3.37E-10
Barium	2.56E+03	2.00E+03	1.23E+05	5.12E-06	8.70E+12	6.79E+12	1.74E+04	2.00E-15
Beryllium	1.98E-02	4.00E+00	6.13E+05	8.27E-07	3.35E+08	6.77E+10	1.40E+04	4.18E-11
Cadmium	3.65E+01	5.00E+00	1.52E+04	4.76E-04	1.53E+10	2.10E+09	2.00E+05	1.30E-11
Chloride	2.50E+05	2.50E+05	5.13E+02	2.11E-03	3.55E+12	3.55E+12	2.99E+04	8.43E-15
Chromium	1.83E+02	1.00E+02	3.45E+03	2.55E-05	1.75E+10	9.54E+09	2.43E+03	1.39E-13
Lead	1.50E+01	1.50E+01	2.45E+05	2.21E-06	1.02E+11	1.02E+11	1.49E+04	1.47E-13
Mercury	3.65E+00	2.00E+00	2.45E+05	2.01E-09	2.47E+10	1.36E+10	1.36E+01	5.51E-16
Nickel	7.30E+02	1.00E+02	2.45E+05	4.96E-07	4.95E+12	6.78E+11	3.35E+03	6.79E-16
Selenium	1.83E+02	5.00E+01	1.03E+04	1.45E-05	5.21E+10	1.42E+10	4.12E+03	7.90E-14
Silver	1.83E+02	1.00E+02	2.21E+05	6.13E-08	1.12E+12	6.10E+11	3.74E+02	3.35E-16
Uranium	1.10E+02	3.00E+01	1.52E+04	1.16E-01	4.62E+10	1.26E+10	4.86E+07	1.05E-09
Zinc	1.10E+04	5.00E+03	3.97E+04	3.26E-01	1.21E+13	5.48E+12	3.58E+08	2.97E-11

ARC = allowable residual contamination
CPP = Chemical Processing Plant
MCL = maximum contaminant level
NA = not available

Table 9. Radionuclide allowable residual contamination inventories assuming a soil source (baseline) and comparison with projected residual inventory.

Nuclide Progeny	10^{-6} Risk-based Water Concentration	Time of Peak Concentration	Predicted Peak Concentration	Risk-based ARC inventory 10^{-6} Risk	Risk-based ARC inventory 10^{-4} Risk	CPP-603A Inventory Current Estimate[a]	Predicted Peak Risk
	(pCi/L)	(years)	(pCi/L)	(Ci)	(Ci)	(Ci)	(Ci)
Am-241[b]	1.46E-01	2.01E+04	—	—	—	—	—
as Np-237	1.60E-01	Am-241 assumed to be all Np-237		8.69E-02	8.69E+00	9.24E-06	1.06E-10
U-233	1.07E+00	—	—	—	—	—	—
Th-229	1.35E-01	—	—	—	—	—	—
C-14	4.62E+01	7.41E+02	4.36E+01	1.06E+00	1.06E+02	6.26E-04	5.91E-10
I-129[c]	2.59E-01	7.58E+02	4.77E+01	5.42E-03	5.42E-01	1.55E-05	2.86E-09
Np-237	1.60E-01	2.01E+04	1.79E+00	8.69E-02	8.69E+00	1.00E-02	1.15E-07
U-233	1.07E+00	—	1.96E-01	—	—	—	—
Th-229	1.35E-01	—	7.17E-03	—	—	—	—
Pu-238[b]	1.63E-01	1.50E+04	—	—	—	—	—
U-234	1.08E+00	Pu-238 assumed to be all U-234		3.84E-01	3.84E+01	2.02E-04	5.26E-10
Th-230	1.28E+00	—	—	—	—	—	—
Ra-226	1.62E-01	—	—	—	—	—	—
Pb-210	4.75E-02	—	—	—	—	—	—
Pu-239	1.52E-01	1.51E+05	2.71E-04	5.50E+02	5.50E+04	4.02E+00	7.31E-09
U-235	1.02E+00	—	1.51E-05	—	—	—	—
Pa-231	3.19E-01	—	1.61E-07	—	—	—	—
Ac-227	7.60E-02	—	1.97E-07	—	—	—	—
Pu-240	1.51E-01	8.70E+04	5.58E-08	3.06E+05	3.06E+07	4.02E+00	1.31E-11
U-236	1.13E+00	—	3.28E-06	—	—	—	—
Th-232	1.45E+00	—	8.21E-13	—	—	—	—
Ra-228	1.92E-01	—	8.21E-13	—	—	—	—
Th-228	2.06E-01	—	8.21E-13	—	—	—	—
Tc-99	3.40E+01	1.00E+03	3.60E+01	9.46E-01	9.46E+01	1.25E-03	1.32E-09
U-234	1.08E+00	1.50E+04	2.28E+00	3.84E-01	3.84E+01	6.96E-01	1.81E-06
Th-230	1.28E+00	—	1.97E-02	—	—	—	—
Ra-226	1.62E-01	—	1.69E-02	—	—	—	—
Pb-210	4.75E-02	—	1.69E-02	—	—	—	—
U-235	1.02E+00	1.52E+04	2.38E+00	4.00E-01	4.00E+01	3.02E-02	7.55E-08
Pa-231	3.19E-01	—	7.84E-03	—	—	—	—
Ac-227	7.60E-02	—	9.57E-03	—	—	—	—
U-238	7.68E-01	1.52E+04	2.38E+00	3.12E-01	3.12E+01	4.78E-03	1.53E-08
U-234	1.08E+00	—	1.00E-01	—	—	—	—
Th-230	1.28E+00	—	4.42E-04	—	—	—	—
Ra-226	1.62E-01	—	3.30E-04	—	—	—	—
Pb-210	4.75E-02	—	3.29E-04	—	—	—	—

a. The ARC inventory is based on the total risk including progeny. The risk for each of the progeny is not shown in this table, but it is calculated in GWSCREEN and incorporated into the calculation of the ARC inventory.
b. Americium-241 is evaluated as Np-237 and Pu-238 is evaluated as U-234.
c. Based on an I-129 MCL of 1 pCi/L, the ARC inventory would be 0.02 Ci.
ARC = allowable residual contamination
CPP = Chemical Processing Plant
MCL = maximum contaminant level

Table 10. Radionuclide allowable residual contamination inventories assuming a grouted source and comparison with projected residual inventory.

Nuclide Progeny	10^{-6} Risk-based Water Concentration	Time of Peak Concentration	Predicted Peak Concentration	Risk-based ARC inventory 10^{-6} Risk	Risk-based ARC inventory 10^{-4} Risk	CPP-603A Inventory Projected in 500 years[a]	Predicted Peak Risk
	(pCi/L)	(years)	(pCi/L)	(Ci)	(Ci)	(Ci)	(Ci)
Am-241[b]	1.46E-01	6.45E+04	—	—	—	—	—
as Np-237	1.60E-01	Am-241 assumed to be all Np-237		1.50E+00	1.50E+02	9.24E-06	6.16E-12
U-233	1.07E+00	—	—	—	—	—	—
Th-229	1.35E-01	—	—	—	—	—	—
C-14	4.62E+01	1.77E+03	1.23E-02	2.21E+00	2.21E+02	5.88E-04	2.66E-10
I-129[c]	2.59E-01	1.45E+03	6.54E-04	6.13E-03	6.13E-01	1.55E-05	2.53E-09
Np-237	1.60E-01	6.45E+04	9.88E-04	1.50E+00	1.50E+02	1.00E-02	6.67E-09
U-233	1.07E+00	—	3.16E-04	—	—	—	—
Th-229	1.35E-01	—	1.77E-05	—	—	—	—
Pu-238[b]	1.63E-01	4.05E+04	—	—	—	—	—
as U-234	1.08E+00	Pu-238 assumed to be all U-234		3.17E+00	3.17E+02	2.02E-04	6.37E-11
Th-230	1.28E+00	—	—	—	—	—	—
Ra-226	1.62E-01	—	—	—	—	—	—
Pb-210	4.75E-02	—	—	—	—	—	—
Pu-239	1.52E-01	1.72E+05	8.95E-05	6.57E+03	6.57E+05	3.96E+00	6.03E-10
U-235	1.02E+00	—	8.75E-06	—	—	—	—
Pa-231	3.19E-01	—	9.70E-08	—	—	—	—
Ac-227	7.60E-02	—	1.19E-07	—	—	—	—
Pu-240	1.51E-01	9.09E+04	9.98E-09	4.93E+06	4.93E+08	3.82E+00	7.75E-13
U-236	1.13E+00	—	8.36E-07	—	—	—	—
Th-232	1.45E+00	—	2.18E-13	—	—	—	—
Ra-228	1.92E-01	—	2.18E-13	—	—	—	—
Th-228	2.06E-01	—	2.18E-13	—	—	—	—
Tc-99	3.40E+01	4.46E+03	6.70E-04	6.35E+01	6.35E+03	1.25E-03	1.97E-11
U-234	1.08E+00	4.05E+04	1.45E-01	3.17E+00	3.17E+02	6.96E-01	2.20E-07
Th-230	1.28E+00	—	3.10E-03	—	—	—	—
Ra-226	1.62E-01	—	2.96E-03	—	—	—	—
Pb-210	4.75E-02	—	2.96E-03	—	—	—	—
U-235	1.02E+00	4.46E+04	7.13E-03	3.77E+00	3.77E+02	3.02E-02	8.01E-09
Pa-231	3.19E-01	—	5.16E-05	—	—	—	—
Ac-227	7.60E-02	—	6.31E-05	—	—	—	—
U-238	7.68E-01	4.46E+04	1.13E-03	2.93E+00	2.93E+02	4.78E-03	1.63E-09
U-234	1.08E+00	—	1.32E-04	—	—	—	—
Th-230	1.28E+00	—	1.57E-06	—	—	—	—
Ra-226	1.62E-01	—	1.43E-06	—	—	—	—
Pb-210	4.75E-02	—	1.42E-06	—	—	—	—

a. The ARC inventory is based on the total risk including progeny. The risk for each of the progeny is not shown in this table, but it is calculated in GWSCREEN and incorporated into the calculation of the ARC inventory.
b. Americium-241 is evaluated as Np-237 and Pu-238 is evaluated as U-234.
c. Based on an I-129 MCL of 1 pCi/L, the ARC inventory would be 0.02 Ci.
ARC = allowable residual contamination
CPP = Chemical Processing Plant
MCL = maximum contaminant level

3. IDENTIFICATION OF REMOVAL ACTION OBJECTIVES AND SCOPE

This section identifies the removal action goals, defines the scope of work, and provides a general schedule for the activities associated with this removal action.

3.1 Removal Action Objectives

The removal action objectives for this non-time critical removal action are as follows:

- Reduce the risk to the Snake River Plain Aquifer by removing the basin water. This water, if released, could serve as a driving force for moving existing vadose zone contaminants to the aquifer.

- Provide a mechanism under CERCLA (42 USC § 9601 et seq.) for disposition of radioactively and metals-contaminated sludge, debris, and water in the CPP-603A Basins.

- Ensure that the risk posed by contaminants remaining at the CPP-603A Basins does not exceed a cumulative carcinogenic risk level of 1×10^{-4} and a total hazard index of one for future residents in 2095 and for current workers.

- Prevent migration of contaminants from the CPP-603A Basins that would cause the Snake River Plain Aquifer groundwater (located outside the INTEC security fence) to exceed a cumulative carcinogenic risk level of 1×10^{-4}, a total hazard index of one, or applicable State of Idaho groundwater quality standards in 2095 and beyond.

These risk-based removal action goals are derived from and are consistent with the remedial action objectives established in the Record of Decision (DOE-ID 1999). The groundwater ingestion exposure pathway is assumed to be the only viable exposure pathway. A surface exposure pathways does not exist from CPP-603A, since the sludge and debris are present 20 ft below ground, the water will be removed, and the basins will be filled with an inert material. This is consistent with the Record of Decision (DOE-ID 1999), where surface pathway risks are assumed to occur for contamination from ground surface to 10 ft below ground surface.

The removal action goals are predicated on the current and future land uses established for INTEC in the Record of Decision (DOE-ID 1999), which includes industrial land use until at least 2095 and possible residential land use thereafter.

3.2 Determination of Removal Action Scope

The scope of this removal action is limited to actions on the contents of the basins, as well as the radioactively contaminated basin interiors, to achieve the removal action goals. The scope does not include deactivation, decontamination, and decommissioning of the remainder of the CPP-603 Complex or other related structures. While the basins are still operational, the SHADO 1 object will be removed, independent of this non-time critical removal action.

3.3 Planned Removal Action Activities and Schedule

This removal action will provide a mechanism for the disposition of radioactively contaminated sludge, debris, water, and basin walls at CPP-603A. The removal action activities depend on the alternative chosen and include the removal and/or in-place stabilization of radioactive sludge, debris, and water in the CPP-603A Basins. The schedule depends on the alternative chosen, but the INEEL planning baseline assumes the removal action will be completed by September 2005.

This EE/CA will be released for a 30-day public comment period. After consideration of the comments received from the public, DOE will confer with the U.S. Environmental Protection Agency (EPA) and Idaho Department of Environmental Quality (DEQ). The EPA and DEQ will review and comment on the EE/CA and concur on the Action Memorandum and DOE will issue an Action Memorandum. The Action Memorandum will identify the selected alternative, whether the one recommended here or one of the other alternatives. A removal action plan will be prepared, which will describe the activities and schedule for implementing the removal action. The removal action will commence upon issuance of the Action Memorandum, which is anticipated in September 2004.

4. IDENTIFICATION AND INITIAL SCREENING OF REMOVAL ACTION ALTERNATIVES

Six alternatives were identified for this removal action, including a no action alternative. The key differences among the alternatives relate to the amount of contaminated materials that might be left in place versus removed from the basins. If sludge is left in place in the basins, the final end state for the CPP-603 Complex must include an engineered cover. In contrast, if the sludge is removed from the basins, the final end state for the CPP-603 Complex will not include an engineered cover, but simply an earthen cover.

4.1 Alternative 1—No Action (Continued Surveillance and Maintenance)

The No Action alternative provides a baseline against which impacts of the other alternatives can be compared. Under the No Action alternative, no removal action would be taken at CPP-603, but the current surveillance and maintenance activities would continue. The basins and their contents would remain as they currently are until deactivation, decontamination, and decommissioning of the CPP-603 Complex are implemented at a later date.

This comparatively inexpensive alternative is easily implemented, incurring only costs associated with surveillance and maintenance. However, the No Action alternative offers no reduction in toxicity, mobility, or volume of contaminants. When the use of the basins for the shielding of highly radioactive material is no longer needed, it would be inappropriate to continue management of the water, sludge, and debris in the basins. This alternative would not meet the removal action objective of removing the basin water to reduce the risk to the Snake River Plain Aquifer. For these reasons, the No Action alternative was screened from further analysis in this EE/CA.

4.2 Alternative 2—Removal and Disposal of Water with Sludge and Debris Grouted in Place

In Alternative 2, the sludge and debris in the basins and canals would be left in place and would be bound up in the initial grout pours. An exception is that the SHADO 1 object would be removed and managed in an appropriate facility.

The basin water would be removed and treated at the ICDF evaporation ponds. As the water is removed, the basins would be filled with grout. The grout would be pumped onto the basin floors to maintain a constant water level. This would reduce the chance of spreading contamination associated with the scum ring on the basin walls by keeping the residue under water. The grout would replace the water that is currently serving to shield the highly radioactive material remaining in the basins. The highly contaminated scum ring on the basin would not be exposed during water removal and grout pumping operations.

This alternative does not meet effectiveness requirements. Characterization of the sludge found high concentrations of cadmium. The sludge was generated by the operations of the CPP-603 basin and will be a hazardous waste, if left in the basin after operations end. Generator treatment of the material within 90 days of the end of operations prevents the material from being regulated as waste. If the sludge were stabilized in the basin, a RCRA landfill closure would be required. Since part of the CPP-603 building is still operating, a landfill closure could not be implemented in accordance with regulations. Since Alternative 2 does not meet the requirements, it was screened from further analysis in this EE/CA.

4.3 Alternative 3—Removal and Disposal of Water and Sludge with Debris Grouted in Place

Alternative 3 would include the removal of water and sludge from the basins and grouting the basin debris in place. The SHADO 1 would be removed and managed in an appropriate facility.

Under Alternative 3, the basin sludge would be removed and treated (stabilized) in high-integrity containers to meet Land Disposal Requirements (40 CFR 268) before disposal in an appropriate landfill. The material should meet the ICDF waste acceptance criteria. After sludge removal, the basin water would be removed and disposed of at the ICDF evaporation ponds. As the water is removed, the basins would be filled with grout. The grout would be pumped onto the basin floors to maintain a constant water level. The highly contaminated scum line on the basin walls would not be exposed during water removal and grout pumping operations. The grout will encapsulate the debris.

Alternative 3 would not trigger a requirement for an engineered cap, because the sludge would be removed and disposed of in a monitored landfill and the encapsulated debris does not pose an unacceptable risk to the aquifer. The final cover requirements for the basins would depend on the final configuration of the entire CPP-603 Complex; however, based on the basins alone, a simple earthen cover would suffice.

4.4 Alternative 4—Removal and Disposal of Water, Sludge, and Debris with Basins Grouted in Place

Alternative 4 is similar to Alternative 3 with the exception that the debris in the basins would be removed. However, removal of the debris does not alter the end state of the CPP-603 Complex. Under Alternative 4, the basin sludge would be removed and treated (stabilized) in high-integrity containers to meet Land Disposal Requirements (40 CFR 268) before disposal in an appropriate landfill. The material should meet the ICDF waste acceptance criteria. Debris would be appropriately sized, packaged, and shipped to the ICDF, Radioactive Waste Management Complex, or other acceptable facility. After sludge and debris removal, the basin water would be removed and disposed of at the ICDF evaporation ponds. As the water is removed, the basins would be filled with grout to provide shielding and contamination control. The grout would be pumped onto the basin floors to maintain a constant water level. The highly contaminated scum ring on the basin would not be exposed during water removal and grout pumping operations.

Alternative 4 would not trigger a requirement for an engineered cap, because the sludge and debris would be removed and disposed of in a lined, monitored landfill. The final cover requirements for the basins would depend on the final configuration of the entire CPP-603 Complex; however, based on the basins alone, a simple earthen cover would suffice.

4.5 Alternative 5—Water, Sludge, and Debris Removal and Disposal with Basin Interior Cleaning, Followed by Fixative and Shielding Installation

Under Alternative 5, the basin sludge would be removed and treated (stabilized) in high-integrity containers to meet Land Disposal Requirements before disposal in an appropriate landfill. The material should meet the ICDF waste acceptance criteria. The basin water would be removed and disposed of at the ICDF evaporation ponds.

A containment barrier would be constructed over the basins to contain airborne contamination during basin contents removal and follow-on activities. Contamination on the concrete basin walls and floors would be physically removed by scrubbing, scabbing, or other methods. A fixative would be applied to the basin interiors if contamination remains that cannot be removed through decontamination efforts. Ongoing maintenance of the fixative would be required. If necessary, lead shielding would be installed to provide additional protection from the contaminants remaining in the basin interior. Contaminated waste generated during decontamination efforts would be stabilized and disposed of at the ICDF or other acceptable facility. After decontamination, the basins would be covered to prevent unintended access.

Alternative 5 would not trigger a requirement for an engineered cap, because the sludge and debris would be removed and disposed of in a monitored landfill. The final cover requirements for the basins would depend on the final configuration of the entire CPP-603 Complex; however, based on the basins alone, a simple earthen cover would suffice.

4.6 Alternative 6—Water, Sludge, Debris, and Basin Floor and Wall Removal and Disposal

Alternative 6 is similar to Alternative 5 except that after the basin walls and floors are cleaned, the concrete basin would be removed and disposed of at the ICDF, Radioactive Waste Management Complex, or other acceptable facility.

The basin sludge would be removed and treated (stabilized) in high-integrity containers to meet Land Disposal Requirements (40 CFR 268) before disposal in an appropriate landfill. The material should meet the ICDF waste acceptance criteria. The debris would be removed, appropriately sized, packaged, and shipped to the ICDF, Radioactive Waste Management Complex, or other acceptable facility. The basin water would be removed and disposed of at the ICDF evaporation ponds.

A containment barrier would be constructed over the basins to contain airborne contamination during basin contents removal and follow-on activities. Contamination on the concrete basin walls and floors would be physically removed by scrubbing, scabbing, or other methods. A fixative would be applied to the basin interiors, if contamination remains that cannot be removed through decontamination efforts. After application of the fixative, the concrete basins would be removed and disposed of at the ICDF, Radioactive Waste Management Complex, or other acceptable facility.

The final state of the basins would depend on the final configuration of the entire CPP-603 Complex; however, based on the basins alone, the excavation would be backfilled and re-contoured.

The removal of the concrete basins is not possible at this time, because the basin walls are adjacent to an integral structural element of the IFSF. Until the IFSF operations cease, Alternative 6 cannot be implemented. The IFSF is expected to continue operations until about 2035. For these reasons, Alternative 6 is not implementable and is screened from further analysis in this EE/CA.

5. ANALYSIS OF ALTERNATIVES

In accordance with the *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA* (EPA 1993), each Alternative was evaluated with respect to (1) effectiveness, (2) implementability, and (3) cost. Much of the information in this section has been extracted from the *Deactivation, Decommissioning, and Dismantlement of the CPP-603A Basin Project, Draft Environmental Assessment* (DOE 2001).

Effectiveness includes protectiveness and the ability to meet the removal action objectives. Protectiveness was evaluated based on protectiveness of the alternative for health and the community, protectiveness of workers, protectiveness of the environment, and compliance with applicable or relevant and appropriate requirements (ARARs).

Implementability was judged based on technical feasibility; availability of equipment, personnel, services, and disposal facilities; and administrative feasibility.

Costs were identified for each alternative, including capital costs, operations and maintenance (O&M) costs, and present net worth costs. The detailed cost estimates are provided in an interoffice memorandum.[a]

5.1 Alternative 3

Alternative 3 would include the removal of water and sludge from the basins and grouting the basin debris in place. The SHADO 1 would be removed and managed in an appropriate facility.

5.1.1 Effectiveness of Alternative 3

This alternative results in the removal of most contaminants from the basins. The contaminants in the debris and affixed to the basin walls and floors would remain in place, stabilized through the addition of grout to the basins. The carbon steel boxes also would remain in place. The two subcriteria for evaluating effectiveness are protectiveness and the ability to meet the removal action objectives.

5.1.1.1 Protectiveness of Alternative 3. Alternative 3 would be protective of public health, community, and the environment when the removal action has been completed, because most of the contaminants present in the CPP-603A Basins would have been removed and those contaminants remaining in the debris and on the basin walls and floors would be immobilized in place. The basin water would be removed and disposed of at the ICDF evaporation ponds. The sludge will be removed, stabilized, and disposed of at the ICDF. Sampling and analysis of the stabilized waste will be completed prior to disposal to confirm that the stabilized sludge meets land disposal restriction requirements. This would place those contaminant sources in a controlled configuration in the ICDF, which is a landfill specifically designed to prevent access to the contaminants from the surface and to prevent contaminants from reaching the Snake River Plain Aquifer in concentrations that would exceed Idaho groundwater quality standards or risk-based limits, as established in the *Final Record of Decision, Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* (DOE-ID 1999). Immobilization of the residual contaminants in the debris and on the basin walls and floors through addition of grout will prevent migration of those contaminants to the Snake River Plain Aquifer in amounts that would exceed the removal action objectives. During the removal action, the action would be protective of health, the community, and the environment through the use of engineering controls.

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a. D. T. Peterson, INEEL Interoffice Memorandum, to B. T. Richards, 2004, "CPP-603 EE/CA Alternatives," Estimate File 2731, June 9, 2004.

During implementation of Alternative 3, the facility radiological engineer estimated the worker exposure (Tomlinson 2004). Dose estimates were derived from estimates of the worker-hours required for specific tasks multiplied by the expected exposure rate. For Alternative 3, the total estimated worker dose of 35.3 rem consists of the following:

- 26.9 rem during sludge removal
- 0.5 rem during water removal
- 7.9 rem during basin grouting.

In addition, air emissions during implementation of this removal action were estimated in "Potential Air Emissions Associated with Deactivation, Decommissioning, and Dismantlement of the CPP-603A Basin Project" (EDF-1931). Table 11 shows the potential emission exposures calculated for three alternatives, which are not identical to the alternatives considered in this EE/CA, but adequately bound the current alternatives. The study also included demolition of the structure around the basins, which is not included in the current definition of Alternative 3. Because the air emissions analysis was inclusive of more demolition activities than would be included in Alternative 3, the results can be used as a bounding case. The "Demolish and Partially Remove" alternative evaluated in EDF-1931 conservatively bounds Alternative 3. In fact, none of the three alternatives shown in Table 11 would cause the air quality ARARs to be exceeded, nor would any of the three alternatives exceed worker or population risk levels as a result of air emissions from the cleanup activities.

Table 11. Air emissions and health effects calculated in EDF-1931 for similar alternatives that encompassed facility demolition.

Removal Action Impacts	Demolish and Partially Remove	Demolish and Grout in Place	Deactivate and Remove
Air emissions			
MEI dose	3.6×10^{-2} mrem/yr	2.5×10^{-2} mrem/yr	7.6×10^{-2} mrem/yr
Worker dose	4.0×10^{1} mrem/yr	2.7×10^{1} mrem/yr	8.5×10^{1} mrem/yr
Population dose	1.4×10^{-1} person-rem/yr	9.6×10^{-2} person-rem/yr	3.0×10^{-1} person-rem/yr
Percentage of background dose	0.001	0.0002	0.007
Health effects—airborne (mrem)			
MEI cancer risk	1.8×10^{-8}	1.2×10^{-8}	3.8×10^{-8}
Worker cancer risk	1.6×10^{-5}	1.1×10^{-5}	3.4×10^{-5}
Population cancer risk	7.0×10^{-5}	4.8×10^{-5}	1.5×10^{-4}

MEI = maximally exposed individual

The calculated dose attributed to air emissions to the maximally exposed individual (MEI) from the alternatives—in combination with the 1999 total effective dose equivalent to the MEI from the entire INEEL (7.92×10^{-3} mrem)—is well below the "National Emission Standards for Hazardous Air Pollutants" (40 CFR 61) 10-mrem dose standard established by the "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" (40 CFR 61, Subpart H). Subpart H states that emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr.

The calculated worker dose from the alternatives would be below the INEEL occupational dose limit of 500 mrem/worker/yr (Table 10). In fact, worker doses likely would be less than those calculated, because the worker is assumed to be at the location of maximum exposure 8 hr/day, every workday for 50 years to receive the maximum inhalation dose and ground surface dose from deposited radionuclides. This is a highly unlikely scenario.

Doses to the population living within 50 mi of INTEC (Table 10) would be low for the alternatives. Although the only dose standard is for the MEI (discussed previously), the dose from the alternatives is well below those received from background sources of radiation in southeast Idaho of about 350 mrem/person/yr.

Based on the available inventory, modelers calculated 1-year average concentrations for cadmium and other carcinogens at the MEI location on the INEEL boundary. All calculated concentrations were below Idaho's acceptable ambient concentrations for carcinogens (EDF-1931).

Alternative 3 would comply with all ARARs and with Idaho hazardous materials management regulations. No variances or waivers would be required for Alternative 3. Table 12 shows the standard practices that would be implemented under all removal action alternatives to address potential compliance concerns common to all alternatives. Standard practices are those actions routinely implemented for any action initiated on the INEEL Site that avoids impacts altogether, minimizes impacts, rectifies impacts, reduces or eliminates impacts, or compensates for the impact. These standard practices would become an integral part of the plan to ensure that the overall effects of the action would not be significant.

Table 12. Standard practices.

Air Emissions. The DOE would limit fugitive dust emissions from removal action activities in compliance with IDAPA 58.01.01.650, "Rules for Control of Fugitive Dust," and best management practices (EPA 1992). As workers remove water from the basins (for Alternatives 2, 3, and 4), they would replace it with grout to control the spread of radioactive contamination. For Alternative 5, the removal action would include actions to limit emissions from and exposure to contaminated surfaces in the basins. In addition, DOE may use localized high-efficiency particulate air filtered enclosures to control radiation releases to the environment during the water removal and/or grouting process. Workers would sequence deactivation activities to reduce radionuclide re-suspension and control emissions.
Soil Erosion. The DOE would keep the disturbed area small and use erosion controls to minimize soil disturbance and loss. In addition, DOE would prepare a revegetation plan and/or a weed control plan for disturbed soil areas.
Water. Since the removal action would occur inside the CPP-603A building, minimal storm water concerns exist. Areas outside the building used to stage and conduct the removal action would be covered to prevent storm water infiltration, and run-off would be directed to the existing INTEC storm water drainage system. The DOE would prevent groundwater contamination in accordance with IDAPA 58.01.11.400, "Ground Water Contamination," by removing and disposing of the 1,500,000 gal of water from the basins and controlling contamination during removal action implementation.
Biology/Ecology. The DOE would relocate or remove (during the non-nesting season) nests of any migratory birds (excluding house sparrows, starlings, and pigeons) found nesting in the CPP-603A Basin Facility.
Cultural Resources. All alternatives would have adverse impacts to the CPP-603A building as a historic INEEL property. The DOE would proceed with any "undertakings" (which refer to a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of an agency; those carried out with federal financial assistance; those requiring a federal permit, license, or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency) in accordance with substantive requirements outlined in a Memorandum of Agreement with the DOE-ID, Idaho State Historic Preservation Office, and the Advisory Council on Historic Preservation. This Memorandum of Agreement was developed through consultations with the signatories and

Table 12. (continued).

other interested parties as required by Section 106 of the "National Historic Preservation Act" (16 USC § 470 et seq.). **Waste**. The DOE would reduce the volume of waste allowing the contaminated water to passively evaporate at the ICDF. All sludge and other solids would be grouted in place for Alternative 2. Hazardous waste would be generated under Alternatives 3, 4, and 5. The sludge would be managed as generator waste under Idaho hazardous materials management regulations. The planned stabilization of the sludge in high-integrity containers would render it nonhazardous. Other types of waste would be managed in compliance with CERCLA applicable or relevant and appropriate requirements.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CPP = Chemical Processing Plant
DOE = U.S. Department of Energy
DOE-ID = U.S. Department of Energy Idaho Operations Office
EPA = U.S. Environmental Protection Agency
ICDF = INEEL CERCLA Disposal Facility
IDAPA = Idaho Administrative Procedures Act
INEEL = Idaho National Engineering and Environmental Laboratory
INTEC = Idaho Nuclear Technology and Engineering Center
USC = *United States Code*

The sludge contains elevated metal concentrations that might exceed the limits described in 40 CFR 261.24, "Toxicity Characteristic," of RCRA. Generator treatment of the sludge to Land Disposal Restriction standards within 90 days after the basin water is no longer needed for shielding meets the hazardous material management requirements. Subsequent disposal of the material as CERCLA waste is allowed. The treated sludge stabilized in high-integrity containers may be disposed of at the ICDF if the final waste form meets the ICDF waste acceptance criteria. Off-Site disposal might be necessary if the ICDF waste acceptance criteria are not met. Hazardous waste determinations would be made, as required, to demonstrate that the stabilized sludge will meet the disposal facility's waste acceptance criteria.

5.1.1.2 Alternative 3—Ability to Achieve Removal Objectives. Alternative 3 would meet the removal action objectives through the removal of the sludge and water from the CPP-603A Basins and the grouting of the basins to immobilize residual contaminants in debris and on the basin walls and floors. The removed contaminants would be stabilized, as required, and disposed of at the ICDF or other acceptable disposal facility. The SHADO 1 would be removed and managed in an appropriate facility. This alternative would leave some residual contaminant source at the CPP-603A Basin location. The main contaminant of concern is Cobalt-60 with a half-life of 5.272 years. Based on the current deactivation schedule for the CPP-603 Complex, the debris containing Cobalt-60 would decay through approximately 5.7 half-lives. The removal action would be expected to serve as the final action for the CPP-603 basins. Once a decision is made on the final end state for the CPP-603 Complex, the removal action will be reevaluated in the context of the remaining actions for the CPP-603 Complex. If it can be demonstrated that, after grouting, the site contributes to the protectiveness of the selected end state for the CPP-603 Complex, no further action would be required. Institutional controls would be required after the removal action is completed to control access to the grouted mass.

5.1.2 Implementability of Alternative 3

5.1.2.1 Technical Feasibility of Alternative 3. Alternative 3 would be technically feasible. The methods used to remove and stabilize basin sludge are not technically complex, but do require special considerations to ensure protection from radiation exposure. The removal, stabilization, and disposal of the basin sludge would require careful operational controls to minimize worker exposure and to prevent the spread of contamination. This removal and treatment scenario initially would use a pump to remove the sludge from the basins and place the sludge in containers.

Water would be removed from the containers by adding flocculent to settle the solids out of suspension. Water would be removed from the containers and placed back into the basins. The next step would add grout (of an appropriate formulation) to the containers and mix it with the suspension to solidify the sludge and by doing so, to ensure that the final waste is a waste not requiring management to meet ARARs for characteristic toxic metals. There are no characteristics of the sludge that would present technical challenges for development of the grout formulation.

After removal of the basin sludge, grout would be pumped into the basins as the water is removed. The water would be sent to the ICDF evaporation pond for disposal. To control the spread of radioactive contamination deposited on the basin walls as the water level recedes, a relatively constant water level would be maintained by displacing the removed water with grout. The grout pumped into the basin will be a controlled low-strength material type of grout specifically formulated to have a low compressive strength, self-leveling, not to settle after hydration, nonhazardous, and easily excavated in the future with conventional digging equipment. The water removal and concomitant grout addition are implementable. Alternative 3 would be expected to take about 14 months to implement.

5.1.2.2 Availability of Alternative 3. Alternative 3 has few constraints with respect to availability. The equipment necessary to implement the removal action is commercially available or is currently available at the INEEL. Personnel and services also would be available. Laboratory testing capabilities exist on the INEEL and would be available for the removal action.

The ICDF would be the assumed location for disposal of the water and treated sludge from the basin. This facility would be available during the duration of the removal action. The water and treated sludge are expected to meet the ICDF waste acceptance criteria for disposal and the facility is expected to be available.

The PEWE was considered and screened out as a possible disposal location for the water, because it would not be capable of accepting the entire volume of water within a 1-year period. The TRA-715 evaporation pond was considered and screened out as a possible water disposal location because of the risks associated with the high number of tanker truck trips, the radiological limitation on transport on public roads, and potential capacity issues.

5.1.2.3 Administrative Feasibility of Alternative 3. Administrative feasibility includes an evaluation of the permits required, easements or right-of-ways required, impacts on adjoining properties, and the ability to implement institutional controls. The entire removal action would be conducted on the INEEL, at and near the INTEC facility, including the ICDF. No permits would be required, since all activities under this CERCLA removal action would take place on-Site within the INTEC area of contamination. Similarly, no easement or right-of-way issues would exist. There would be no impacts on adjoining properties from implementation of Alternative 3.

The current safety authorization basis document prohibits the removal of sludge from the basin. This document would have to be revised and approved to allow sludge removal in order to implement Alternative 3. A generator treatment plan would be prepared for the removal and treatment of sludge from the basins.

The INEEL has the ability to establish and maintain institutional controls through its CERCLA program. For Alternative 3, institutional controls would be required after completion of the removal action to maintain protectiveness. Before and during the removal action, the existing institutional controls at INTEC would restrict access and prevent exposure.

5.1.3 Cost of Alternative 3

The cost to implement Alternative 3 is $4.8 million. In net present value, this equates to $4.3 million. The capital costs include costs for the transfer of water to the ICDF and solidified sludge to the ICDF, but the capital costs do not include costs for disposal. A 20-year O&M period is the assumed time between completion of the removal action and start of the final decontamination and decommissioning of the facility. The O&M costs included in the total cost above are estimated at $0.4 million. The detailed cost estimate is provided in an interoffice memorandum (see footnote a).

5.2 Alternative 4

Alternative 4 would include the removal and disposal of basin water, sludge, and debris with disposal of this waste at the ICDF. After removal of the contents, the basins would be grouted in place. It differs from Alternative 3 only in that the basin debris would be removed and disposed of at the ICDF.

5.2.1 Effectiveness of Alternative 4

This alternative results in the removal of most contaminants from the CPP-603A. Fixed contamination on the basin walls or floor may remain in place after decontamination. The two subcriteria for evaluating effectiveness are protectiveness and the ability to meet the removal action objectives.

5.2.1.1 Protectiveness of Alternative 4. This alternative would be protective of public health, the community, and the environment when the removal action has been completed, because most of the contaminants present in the CPP-603A Basins would no longer be present and those remaining would be stabilized in place. The removed contaminants would be stabilized, as required, and disposed of at the ICDF. This would place the contaminant source in a controlled configuration in a landfill specifically designed to prevent access to the contaminants from the surface and to prevent contaminants from migrating to groundwater.

Worker exposure during implementation of Alternative 4 was estimated by the facility radiological engineer (Tomlinson 2004). Dose estimates were derived from estimates of the worker-hours required for specific tasks multiplied by the expected exposure rate. For Alternative 4, the total estimated worker dose of 44.3 rem consists of the following:

- 35.9 rem during sludge and debris removal
- 0.5 rem during water removal
- 7.9 rem during basin grouting.

Air emissions during implementation of this removal action were estimated in EDF-1931. Table 11 shows the potential emission exposures calculated for three alternatives, which are not identical to the alternatives considered in this EE/CA, but adequately bound the current alternatives. The study also included demolition of the structure around the basins, which is not included in the current definition of Alternative 4. Because the air emissions analysis was inclusive of more demolition activities than would be included in Alternative 4, the results can be used as a bounding case. Because the air emissions analysis was inclusive of more demolition activities than would be included in Alternative 4, the results of the “Deactivate and Remove” alternative can be used as a bounding case. As indicated in Section 5.1.1.1, none of the three alternatives shown in Table 11 would cause the air quality ARARs to be exceeded, nor would any of the three alternatives exceed worker or population risk levels as a result of air emissions from the cleanup activities.

Alternative 4 would comply with all ARARs and with Idaho hazardous materials management regulations. No variances or waivers would be required for Alternative 4. Table 12 shows the standard practices that would be implemented under all removal action alternatives to address potential compliance concerns common to all alternatives.

The sludge contains elevated metal concentrations that might exceed the limits described in 40 CFR 261.24, “Toxicity Characteristic,” of RCRA. Generator treatment of the sludge to Land Disposal Restriction standards within 90 days after the basin water is no longer needed for shielding meets the hazardous material management requirements. Subsequent disposal of the material as CERCLA waste is allowed. The treated sludge stabilized in high-integrity containers may be disposed of at the ICDF if the final waste form meets the ICDF waste acceptance criteria. Off-Site disposal might be necessary if the ICDF waste acceptance criteria are not met. Hazardous waste determinations would be made, as required, to demonstrate that the stabilized sludge will meet the disposal facility’s waste acceptance criteria.

5.2.1.2 Alternative 4—Ability to Achieve Removal Objectives. Alternative 4 would meet the removal action objectives by removing the water, sludge, and debris from the CPP-603A. The contaminants would be stabilized, as required, and disposed of at the ICDF or other acceptable facility. The SHADO 1 would be removed and managed in an appropriate facility. This alternative will leave limited, if any, residual contaminant source at the CPP-603A Basin location. The removal action would be expected to serve as the final action for the CPP-603 basins. Once a decision is made on the final end state for the CPP-603 Complex, the removal action will be reevaluated in the context of the remaining actions for the CPP-603 Complex. If it can be demonstrated that, after grouting, the site contributes to the protectiveness of selected end state for the CPP-603 Complex, no further action would be required. Institutional controls would be required after the removal action is completed to prevent access to the grouted mass.

5.2.2 Implementability of Alternative 4

5.2.2.1 Technical Feasibility of Alternative 4. Alternative 4 would be technically feasible, but presents technical challenges that would not exist with the other alternatives. The removal, stabilization, and disposal of the basin sludge and debris would require careful operational controls to minimize worker exposure and to prevent the spread of contamination. The water would be sent to the ICDF evaporation ponds.

The sludge would be pumped into high-integrity containers. Water would be removed from the containers and sent to the ICDF evaporation ponds. The final step would add grout (of an appropriate formulation) to the high-integrity containers and mix it with the suspension to solidify the sludge and by doing so, to ensure that the final waste does not require management to meet ARARs for characteristic toxic metals. Debris removed from the basins also may be stabilized using grout with prior sizing of the debris to fit in containers (as necessary). There are no characteristics of the sludge that would present technical challenges in developing a grout formulation. Alternative 4 would be expected to take about 18 months to implement.

5.2.2.2 Availability of Alternative 4. Alternative 4 has few constraints with respect to availability. The equipment necessary to implement the removal action is commercially available or is currently available at the INEEL. Personnel and services also would be available. Alternative 4 would require few personnel and services to implement the removal action. Laboratory testing capabilities exist on-Site and would be available for the removal action. The ICDF would be available for the disposal of the water, sludge, and debris generated under Alterative 4.

The PEWE was considered and screened out as a possible water disposal location, because it would not be capable of accepting the entire volume of water within a 1-year period. The TRA-715 evaporation pond was considered and screened out as a possible water disposal location because of the risks associated with the high number of tanker truck trips, the radiological limitation on transport on public roads, and potential capacity issues.

5.2.2.3 Administrative Feasibility of Alternative 4. Administrative feasibility includes an evaluation of the permits required, easements or right-of-ways required, impacts on adjoining properties, and the ability to implement institutional controls. The entire removal action would be conducted on the INEEL, at and near the INTEC facility, including the ICDF. No permits would be required, since all activities under this CERCLA removal action would take place on-Site within the INTEC area of contamination. Similarly, no easement or right-of-way issues would exist. There would be no impacts on adjoining properties from implementation of Alternative 4. Finally, the INEEL has the ability to establish and maintain institutional controls through its CERCLA program. For Alternative 4, institutional controls would be required after completion of the removal action to maintain protectiveness. Before and during the removal action, the existing institutional controls at the INTEC would restrict access and prevent exposure.

The current safety authorization basis document, SAR-116, prohibits the removal of sludge from the basin. This document would have to be revised and approved to allow sludge removal in order to implement Alternative 4. A generator treatment plan would be prepared for the removal and treatment of sludge from the basins.

5.2.3 Cost of Alternative 4

The cost to implement Alternative 4 is $5.9 million. In net present value, this equates to $5.5 million. The capital costs include costs for the transfer of water to the ICDF, solidified sludge to the ICDF, and debris to the ICDF or Radioactive Waste Management Complex, but the capital costs do not include costs for disposal. A 20-year O&M period is the assumed time between completion of the removal action and start of the final decontamination and decommissioning of the facility. The O&M costs included in the total cost above are estimated at $0.4 million. The detailed cost estimate is provided in an interoffice memorandum (see footnote a).

5.3 Alternative 5

Alternative 5 is the same as Alternative 4 with the exception that instead of filling the basins with grout, the basin interiors would be cleaned and shielded (as necessary). After cleaning, the basins would eventually be backfilled with soil. As with the other alternatives, SHADO 1 would be removed and managed in an appropriate facility.

5.3.1 Effectiveness of Alternative 5

This alternative would result in the removal of most of the contaminants in the basins. Limited fixed contamination on the basin walls or floor may remain in place after decontamination, but would be shielded if activities remain high. The two subcriteria for evaluating effectiveness are protectiveness and the ability to meet the removal action objectives.

5.3.1.1 Protectiveness of Alternative 5. Alternative 5 would be protective of public health, the community, and the environment when the removal action has been completed, because most of the contaminants present in the CPP-603A Basins would no longer be present and those remaining would be shielded in place. The removed contaminants would be stabilized, as required, and disposed of at the

ICDF. This would place the contaminant source in a controlled configuration in a landfill specifically designed to prevent access to the contaminants from the surface and to prevent contaminants from migrating to the groundwater.

During the removal action, the action would be protective of health, the community, and the environment through the use of engineering controls. The potential for worker exposure is high, because the cleaning of the basin walls and floors would require labor-intensive effort. A containment barrier would be necessary to minimize worker exposure during removal of contamination and installation of shielding on the basin walls and floors.

Worker exposure during implementation of Alternative 5 was estimated by the facility radiological engineer (Tomlinson 2004). Dose estimates were derived from estimates of the worker-hours required for specific tasks multiplied by the expected exposure rate. For Alternative 5, the total estimated worker dose of 77.2 rem consists of the following:

- 35.9 rem during sludge and debris removal
- 22.8 rem during construction of the basin containment
- 5.0 rem during installation of shielding (if needed)
- 13.0 rem during basin decontamination and fixative application utilizing nuclear divers
- 0.5 rem during water removal.

Air emissions during implementation of this removal action were estimated in EDF-1931. Table 11 shows the potential emission exposures calculated for three alternatives, which are not identical to the alternatives considered in this EE/CA, but adequately bound the current alternatives. The study also included demolition of the structure around the basins, which is not included in the current definition of Alternative 5. Because the air emissions analysis was inclusive of more demolition activities than would be included in Alternative 5, the results of the "Deactivate and Remove" alternative can be used as a bounding case.

As shown in Table 11, Alternative 5 has the highest predicted increase in potential air emissions because of an increase in use of contaminant-control techniques with higher applicable re-suspension factors that likely would be required during decontamination of the CPP-603 Basins. However, as indicated in Section 5.1.1.1, none of the three alternatives shown in Table 11 would cause the air quality ARARs to be exceeded, nor would any of the three alternatives exceed worker or population risk levels as a result of air emissions from the cleanup activities.

Alternative 5 would comply with all ARARs and with Idaho hazardous materials management regulations. No variances or waivers would be required for Alternative 3. Table 12 shows the standard practices that would be implemented under all removal action alternatives to address potential compliance concerns common to all alternatives.

The sludge contains elevated metal concentrations that might exceed the limits described in 40 CFR 261.24, "Toxicity Characteristic," of RCRA. Generator treatment of the sludge to Land Disposal Restriction standards within 90 days after the basin water is no longer needed for shielding meets the hazardous material management requirements. Subsequent disposal of the material as CERCLA waste is allowed. The treated sludge stabilized in high-integrity containers may be disposed of at the ICDF if the final waste form meets the ICDF waste acceptance criteria. Off-Site disposal might be necessary if the

ICDF waste acceptance criteria are not met. Hazardous waste determinations would be made, as required, to demonstrate that the stabilized sludge will meet the disposal facility's waste acceptance criteria.

5.3.1.2 Alternative 5—Ability to Achieve Removal Objectives. Alternative 5 would meet the removal action objectives by removing the water, sludge, and debris from the CPP-603A Basins and subsequently decontaminating the basin walls and floors. Lead shielding may be installed, if high activities remain after decontamination. The contaminants would be stabilized, as required, and disposed of at the ICDF or other acceptable facility. The SHADO 1 would be removed and managed in an appropriate facility. This alternative will leave limited, if any, residual contaminant source at the CPP-603A Basin location and the remaining contamination would be shielded in place, if necessary. Once a decision is made on the final end state for the CPP-603 Complex, the removal action would be reevaluated in the context of the remaining actions for the CPP-603 Complex. If it can be demonstrated that, after grouting, the site contributes to the protectiveness of the selected end state for the CPP-603 Complex, no further action would required. The basins could be released for unrestricted access and unlimited use. Institutional controls would be required after the removal action is completed to prevent access to the shielded basin walls and floors.

5.3.2 Implementability of Alternative 5

5.3.2.1 Technical Feasibility of Alternative 5. Alternative 5 would be technically feasible. The water would be pumped out and sent to the ICDF evaporation pond through a temporary pipeline. The removal, stabilization, and disposal of the basin sludge and debris would require careful operational controls to minimize worker exposure and to prevent the spread of contamination.

The sludge would be pumped into high-integrity containers. Water would be removed from the containers and sent to the ICDF evaporation ponds. The final step would add grout (of an appropriate formulation) to the high-integrity containers and mix it with the suspension to solidify the sludge and by doing so, to ensure that the final waste does not require management to meet ARARs for characteristic toxic metals. Debris removed from the basins also would be stabilized using grout with prior sizing of the debris to fit in containers (as necessary). There are no characteristics of the sludge that would present technical challenges in developing a grout formulation.

Installation of a containment barrier over the basins would be necessary as the water is withdrawn to prevent exposure to and the spread of contamination on the basin walls. This would present challenges in maintaining worker exposure as low as reasonably achievable during the process. However, the technical capability to design and implement barriers is available at the INEEL.

After the contents of the basins are removed, decontamination of the basin walls and floors would commence, using scrubbing or scabbing methods. Decontamination is technically feasible, but creates opportunities for worker exposure and the potential spread of contamination. Barriers would be necessary to prevent scrubbing or scabbing activities from releasing contaminants to the ambient air. Underwater methods might be necessary to minimize worker exposure. Alternative 5 would be expected to take 2 to 3 years to implement.

5.3.2.2 Availability of Alternative 5. Alternative 5 has few constraints with respect to availability. The equipment necessary to implement the removal action is commercially available or is currently available at the INEEL. Personnel and services also would be available. Laboratory testing capabilities exist on-Site and would be available for the removal action.

The ICDF, which will be in active operation during the removal action, is the location for the disposal of the basin water. Based on analytical data available to date, the water from the CPP-603A

Basin is expected to meet the contaminant-specific concentration or activity limits of the ICDF evaporation pond's waste acceptance criteria.

The PEWE was considered and screened out as a possible disposal location, because it would not be capable of accepting the entire volume of water within a 1-year period. The TRA-715 evaporation pond was considered and screened out as a possible disposal location because of the risks associated with the high number of tanker truck trips, the radiological limitation on transport on public roads, and potential capacity issues.

5.3.2.3 Administrative Feasibility of Alternative 5. Administrative feasibility includes an evaluation of the permits required, easements or right-of-ways required, impacts on adjoining properties, and the ability to implement institutional controls. The entire removal action would be conducted on the INEEL, at and near the INTEC facility, including the ICDF evaporation pond. No permits would be required, since all activities under this CERCLA removal action would take place on-Site within the INTEC area of contamination. Similarly, no easement or right-of-way issues would exist. There would be no impacts on adjoining properties from implementation of Alternative 5. Finally, the INEEL has the ability to establish and maintain institutional controls through its CERCLA program. For Alternative 5, institutional controls would be required after completion of the removal action to maintain protectiveness. Before and during the removal action, the existing institutional controls at INTEC would restrict access and prevent exposure.

The current safety authorization basis document, SAR-116, prohibits the removal of sludge from the basin. This document would have to be revised and approved to allow sludge removal in order to implement Alternative 5. A generator treatment plan would be prepared for the removal and treatment of sludge from the basins.

5.3.3 Cost of Alternative 5

The cost to implement Alternative 5 is $7.0 million. In net present value, this equates to $5.8 million. This estimate includes capital costs and O&M costs. The capital costs include costs for the transfer of water to the ICDF, solidified sludge to the ICDF, and debris to the ICDF or the Radioactive Waste Management Complex, but the capital costs do not include costs for disposal. A 20-year O&M period is the assumed time between completion of the removal action and start of the final decontamination and decommissioning of the facility. The O&M costs included in the total cost above are estimated at $1.0 million. The detailed cost estimate is provided in an interoffice memorandum (see footnote a).

6. COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The DOE compared the alternatives described in Sections 4 and 5 and prefers Alternative 3, because it reduces the potential risk to the aquifer, satisfies the remedial action objectives of the Record of Decision (DOE-ID 1999), protects site workers taking the action, complies with regulations, and is cost effective. Alternative 1 does not reduce potential risk to the aquifer. Alternative 2 does not comply with regulations regarding the management of hazardous material. Alternative 4 reduces the potential risk to the aquifer, satisfies the remedial action objectives of the Record of Decision (DOE-ID 1999), and complies with regulations but is less protective of the workers taking the action. Alternative 5 reduces potential risk to the aquifer, satisfies the remedial action objectives of the Record of Decision (DOE-ID 1999), complies with regulations, and has greater worker risk than Alternatives 3 and 4. Alternative 1, as stated in Section 4, does not reduce risk to the aquifer and Alternative 6 is not implementable. Table 13 provides a brief summary of the material provided in Section 5 with respect to each selection criterion. Table 14 provides greater detail on comparative costs.

Table 13. Comparative analysis of alternatives that pass the initial screening.

Feature		Alternative 3—Removal and Disposal of Water and Sludge with Debris Grouted in Place	Alternative 4—Removal and Disposal of Water, Sludge, and Debris with Basins Grouted in Place	Alternative 5—Removal and Disposal of Water, Sludge, and Debris with Basin Interior Cleaning, Followed by Fixative and Shielding Installation
EFFECTIVENESS	Protectiveness	Alternative 3 would be less than Alternatives 4 and 5, because debris and fixed contamination would remain in the debris and on the basin floors and walls. The basin sludge and water would be removed from the basins and disposed of in a monitored landfill. The contamination remaining in the basins would be immobilized in place. The risk assessment in Section 2.5 demonstrates that leaving these contaminants in place would not cause the concentrations of contaminants in the aquifer to exceed groundwater quality standards or to exceed the risk levels identified in the removal action objectives. Alternative 3 is best in protection of workers because of lesser amount of handling of contaminated materials. In contrast to Alternatives 4 and 5, this alternative would only require handling of the water and sludge during removal. Total worker exposure is estimated to be 35.3 rem.	Alternative 4 would be more protective than Alternative 3, because the contaminants in the sludge, water, and debris would be removed, but less than Alternative 5 because fixed contamination would remain on the basin floors and walls. The basin sludge, water, and debris would be removed from the basins and disposed of in a monitored landfill. The contamination remaining in the basins would be immobilized in place. The risk assessment in Section 2.5 demonstrates that leaving these contaminants in place would not cause the concentrations of contaminants in the aquifer to exceed groundwater quality standards or to exceed the risk levels identified in the removal action objectives. Alternative 4 would fall between Alternatives 3 and 5 in terms of worker exposure. The additional handling of the basin debris would result in greater worker exposure than Alternative 3. Total worker exposure is estimated to be 44.3 rem.	Of the alternatives, Alternative 5 would have the greatest protectiveness once the removal action is completed, because most of the contaminants would be removed from the basins. The water, sludge, debris, and decontamination waste would then reside in a monitored landfill. Alternative 5 would have the lowest protectiveness in terms of worker exposure. Alternative 5 would have the highest worker exposure because of handling of the water, sludge, and debris that would be removed from the basin and the additional labor required in physically removing contamination from the basin floors and walls. Total worker exposure is estimated to be 77.2 rem. Alternative 5 would have the greatest risk of a release to the air during implementation of the removal action, but Table 10 demonstrates that this risk is well below the applicable requirements.

Table 13. (continued).

	Feature	Alternative 3—Removal and Disposal of Water and Sludge with Debris Grouted in Place	Alternative 4—Removal and Disposal of Water, Sludge, and Debris with Basins Grouted in Place	Alternative 5—Removal and Disposal of Water, Sludge, and Debris with Basin Interior Cleaning, Followed by Fixative and Shielding Installation
EFFECTIVENESS	Ability to achieve remedial objectives	Alternative 3 would achieve the OU 3-13 remedial action objectives, meeting the requirement for protectiveness of human health and the environment. Alternative 3 would require institutional controls, because the debris and contamination on the basin walls and floors would be left in place.	Alternative 4 would achieve the OU 3-13 remedial action objectives, meeting the requirement for protectiveness of human health and the environment. Alternative 4 would require institutional controls, because the contamination on the basin walls and floors would be left in place.	Alternative 5 would achieve the OU 3-13 remedial action objectives, meeting the requirement for protectiveness of human health and the environment. Alternative 5 would require institutional controls, because although the contaminated water, sludge, debris, and as much fixed contamination as possible would be removed, some contamination might remain on the basin walls and floors.
IMPLEMENTABILITY	Technical feasibility	Alternative 3 is technically feasible. It would present technical challenges associated with the removal of water and sludge from the basins and the necessary stabilization of the sludge prior to disposal. Alternative 3 would require about 14 months to implement.	Alternative 4 is technically feasible. It would present many of the same technical challenges as Alternative 5, but would not include the challenges associated with the decontamination of the basin walls and floors and contamination containment and shielding following water removal. Alternative 4 would be slightly more technically challenging than Alternative 3, because Alternative 4 includes the removal of debris. Alternative 4 would require about 18 months to implement.	Alternative 5 would be the most difficult to implement from a technical perspective. The removal, stabilization, and disposal of the basin water, sludge, and debris would require careful operational controls to minimize worker exposure and to prevent the spread of contamination. The installation of barriers would be necessary, since the water is withdrawn to prevent exposure to and the spread of contamination on the basin walls. This would present challenges in maintaining worker exposure as low as reasonably achievable during the process. However, the technical capability to design and implement barriers is resident at the INEEL. Specially designed underwater methods might be necessary to remove contamination from the basin walls and floors, if worker exposure is predicted to be too high. However, the technical capability

Table 13. (continued).

Feature		Alternative 3—Removal and Disposal of Water and Sludge with Debris Grouted in Place	Alternative 4—Removal and Disposal of Water, Sludge, and Debris with Basins Grouted in Place	Alternative 5—Removal and Disposal of Water, Sludge, and Debris with Basin Interior Cleaning, Followed by Fixative and Shielding Installation
				to such equipment is available to the INEEL. Alternative 5 would require about 2 years to implement.
IMPLEMENTABILITY	Availability	Alternative 3 would require the availability of the ICDF for the disposal of sludge. As long as the waste generated meets the ICDF waste acceptance criteria, there should be no issue with the availability of the ICDF for disposal. Alternative 4 would require the ICDF evaporation ponds for disposal of the liquid waste. At this time, the availability of the ICDF to accept the volume of water that would be generated in this removal action is assumed based on anticipated changes to the waste acceptance criteria.	Same as Alternative 3, with the exception that debris also would be disposed of at the ICDF. Some debris may be disposed of at the Radioactive Waste Management Complex, which would be available to accept the waste if it meets the facility waste acceptance criteria.	Same as Alternative 4 with respect to the availability of disposal locations. Although Alternative 5 would require more resources to accomplish the decontamination of the basins, those resources are available at the INEEL or through subcontracts.

Table 13. (continued).

	Feature	Alternative 3—Removal and Disposal of Water and Sludge with Debris Grouted in Place	Alternative 4—Removal and Disposal of Water, Sludge, and Debris with Basins Grouted in Place	Alternative 5—Removal and Disposal of Water, Sludge, and Debris with Basin Interior Cleaning, Followed by Fixative and Shielding Installation
IMPLEMENTABILITY	Administrative feasibility	For all alternatives, the entire removal action would be conducted on the INEEL, at and near the INTEC facility, including the ICDF. No permits would be required, since all actions will take place on-Site under CERCLA. Similarly, no easement or right-of-way issues would exist. There would be no impacts on adjoining properties from implementation of the alternatives. The safety documentation for the basins would have to be modified to allow removal of the sludge. A generator treatment plan would be required to address removal and treatment of the sludge.	Same as Alternative 3 with the possible exception that if some debris is disposed of at the Radioactive Waste Management Complex, travel across a public highway will be required. The INEEL routinely manages similar shipments to the Radioactive Waste Management Complex from other locations within the INEEL.	Same as Alternative 4
COST	Capital costs (escalated)	$3.9 million	$5.1 million	$6.1 million
	O&M costs (escalated)	$0.9 million	$0.9 million	$1.0 million
	Total escalated cost	$4.8 million	$6.0 million	$7.1 million
	Net present value total cost	$4.3 million	$5.5 million	$5.8 million
	Cost ranking	1	2	3

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
ICDF = INEEL CERCLA Disposal Facility
INEEL = Idaho National Engineering and Environmental Laboratory
INTEC = Idaho Nuclear Technology and Engineering Center
O&M = operations and maintenance
OU = operable unit

Table 14. Comparative costs.

Level	Description	Estimate Subtotal ($)	Escalation ($)	Contingency ($)	Contingency (%)	Total
1.3	Option 3	4,406,900	420,013	0	0.00	4,826,912
1.3.1	Sludge removal	1,550,350	72,091	0	0.00	1,622,441
1.3.2	Basin water removal to ICDF evaporation pond	486,892	22,640	0	0.00	509,532
1.3.3	Basin grouting with rapid water removal	585,398	27,221	0	0.00	612,619
1.3.4	Earth cap over building footprint	552,106	25,673	0	0.00	577,779
1.3.5	Project management and support	481,659	22,397	0	0.00	504,057
1.3.6	Surveillance and maintenance costs	750,494	249,990	0	0.00	1,000,484
1.4	Option 4	5,572,460	474,211	0	0.00	6,046,671
1.4.1	Sludge removal	1,550,350	72,091	0	0.00	1,662,441
1.4.2	Debris removal	930,678	43,277	0	0.00	973,954
1.4.3	Basin water removal to ICDF evaporation pond	486,892	22,640	0	0.00	509,532
1.4.4	Basin grouting with rapid water removal	585,398	27,221	0	0.00	612,619
1.4.5	Earth cap over building footprint	552,106	25,673	0	0.00	577,779
1.4.6	Project management and support	716,542	33,319	0	0.00	749,861
1.4.7	Surveillance and maintenance costs	750,494	249,990	0	0.00	1,000,484
1.5	Option 5	6,141,564	1,029,278	0	0.00	7,170,842
1.5.1	Basin water removal to ICDF evaporation pond	486,892	22,640	0	0.00	509,532
1.5.2	Sludge removal	1,550,350	72,091	0	0.00	1,662,441
1.5.3	Debris removal	930,678	43,277	0	0.00	973,954

Table 14. (continued).

Level	Description	Estimate Subtotal ($)	Escalation ($)	Contingency ($)	Contingency (%)	Total
1.5.4	Basin containment for airborne Contamination	626,628	29,138	0	0.00	655,766
1.5.5	Basin decontamination/stabilization	448,365	20,849	0	0.00	469,214
1.5.6	Project management and support	481,659	22,397	0	0.00	504,057
1.5.7	Surveillance and maintenance costs	831,494	276,971	0	0.00	1,108,465
1.5.8	Earth cap over building footprint	552,106	380,898	0	0.00	993,004
1.5.9	Remove and dispose of basin cover and shielding and basin fill	233,392	161,017	0	0.00	394,408

ICDF = INEEL CERCLA Disposal Facility

7. RECOMMENDED REMOVAL ACTION ALTERNATIVE

The DOE compared the alternatives described in Sections 4 and 5 and prefers Alternative 3, because it reduces the potential risk to the aquifer, satisfies the remedial action objectives of the Record of Decision (DOE-ID 1999), protects site workers taking the action, complies with regulations, is cost effective, and addresses public preferences, as understood from comments on previous removal actions. Alternative 1 does not reduce potential risk to the aquifer. Alternative 2 does not comply with regulations regarding the management of hazardous material. Alternative 4 reduces the potential risk to the aquifer, satisfies the remedial action objectives of the Record of Decision (DOE-ID 1999), and complies with regulations but does not protect the workers taking the action to the same degree as provided by Alternative 3. Implementation of either Alternative 3 or 4 would result in virtually the same end state for the CPP-603 Complex since the activated debris will decay significantly by the time the final action is taken at the CPP-603 Complex (currently assumed to be 2035). Alternative 5, like Alternative 3, reduces potential risk to the aquifer, satisfies the remedial action objectives of the Record of Decision (DOE-ID 1999), and complies with regulations but is more costly and has greater worker risk than Alternative 3.

Alternative 3 would include the removal of water and sludge from the basins followed by grouting the basin in place. The SHADO 1 would be removed and managed in an appropriate facility. Under Alternative 3, the basin sludge would be removed and stabilized in high-integrity containers before disposal at the ICDF. After sludge removal, the basin water would be removed and disposed of at the ICDF evaporation ponds. As the water is removed, the basins would be filled with grout. The grout would be pumped onto the basin floors to maintain a constant water level. The grout pumped into the basin will be a controlled low-strength material type of grout specifically formulated to have a low compressive strength, self-leveling, not to settle after hydration, nonhazardous, and easily excavated in the future with conventional digging equipment. The highly contaminated scum ring on the basin would not be exposed during water removal and grout pumping operations.

Alternative 3 would not trigger a requirement for an engineered cap, because the sludge would be removed and disposed of in a lined, monitored landfill. The radioactivity in the debris is relatively short lived. The final cover requirements for the basins would depend on the final configuration of the entire CPP-603 Complex; however, based on the basins alone, a simple earthen cover would suffice. The removal action objectives and remedial action objectives of the Record of Decision (DOE-ID 1999) will be met through this alternative.

7.1 Compliance with Environmental Regulations, Including Those that are Applicable or Relevant and Appropriate Requirements

Alternative 3 will comply with environmental regulations, including those that are ARARs. The actions proposed to remove basin water and sludge include generator treatment of hazardous materials as well as management of CERCLA waste in accordance with ARARs. Currently, the basins are kept full of water to provide shielding for a spent nuclear fuel-like item (a small high-activity debris object designated SHADO 1 [EDF-4271]); other items containing fission material; basin sludge, which contains activated metals; and radioactive contamination adhering to and/or embedded in the interior basin surfaces. Characterization of the basin sludge showed it also contains high levels of cadmium (greater then 1 mg/kg). The sludge must be managed in compliance with Idaho's hazardous material regulations. The proposed non-time critical removal action will provide an umbrella for the entire basin deactivation, but it will not replace compliance with any regulations.

Table 15 lists the CERCLA ARARs that have been identified for Alternative 3. These ARARs are a compilation and expansion of the ARARs identified in the Record of Decision (DOE-ID 1999). The ARARs list is based on several key assumptions:

- Management of CERCLA waste will be subject to meeting the waste acceptance criteria of the receiving facility, whether that facility is an on-INEEL facility (such as the ICDF, Radioactive Waste Management Complex, INEEL Landfill Complex at the Central Facilities Area) or an off-INEEL facility. The ICDF is the preferred location for disposal of contaminated CERCLA waste from Waste Area Group 3.

- Currently, the basins are kept full of water to provide shielding for spent nuclear fuel-like items (e.g., SHADO), other items containing fissile material (e.g., sludge), and activated metals—all with significant radioactivity—as well as radioactive contamination adhering to and/or embedded in the interior basin surfaces. Because the basins continue to actively provide shielding for the SHADO, the basins are still in operation and are not being used for the management of hazardous waste.

- The water to be removed from the basins is expected to not have the characteristics of a hazardous waste. It is not expected to require management to meet ARARs. However, water characterization will be necessary to confirm that the water meets the waste acceptance criteria of the ICDF evaporation ponds prior to disposal.

- The CERCLA waste that may be generated during implementation of the removal action will be handled in accordance with the ARARs identified in Table 15. As this would be CERCLA waste generated within the Waste Area Group 3 area of contamination, Land Disposal Restrictions are not applicable unless placement is triggered or treatment is performed. As the sludge, once removed, would be treated under a generator treatment plan, Land Disposal Requirements would be triggered, and the treatment must meet the Land Disposal Requirements.

- For any waste disposal at a location other than the ICDF, EPA Region 10 will be contacted for an Off-Site Rule determination (40 CFR 300.440).

In addition to ARARs, there are other requirements that would apply to the removal action. They are not classified as ARARs, because either they are not environmental regulations or they are environmental regulations that have administrative, rather than substantive, requirements. These requirements are described in the following paragraphs.

Section 106 of the "National Historic Preservation Act" (16 USC § 470 et seq.), as amended, requires agencies to consider the impact of undertakings on properties listed or eligible for listing in the National Register of Historic Places and to consult with the Idaho State Historic Preservation Office and other interested parties when impacts are likely. In addition, the "Archaeological Resources Protection Act of 1979" (16 USC § 470aa–470mm), as amended, provides for the protection and management of archaeological resources on federal lands. This will be done in coordination with the deactivation schedule.

The DOE is required to review as guidance the most current United States Fish and Wildlife Service list for threatened and endangered plant and animal species. If, after reviewing the list, DOE determines that Alternative 3 would not impact any threatened and endangered species, DOE may determine or document that formal consultation with the United States Fish and Wildlife Service is not required for this action. The DOE has determined that a biological assessment would not be required for any of the alternatives.

7.2 Achieving Removal Action Goals

The recommended Alternative 3 would meet the removal action objectives through the removal and disposal of the water and sludge. This alternative would leave debris and residual contaminant sources at the CPP-603A Basin on the basin walls and floors, but these contaminants would be grouted in place. Immobilization of the debris and residual contaminants on the basin walls and basin floors through addition of grout would prevent migration of those contaminants to the Snake River Plain Aquifer in amounts that would exceed the removal action objectives. The grouted mass also would prevent access to the residual contaminants from surface receptors.

The removal action would be expected to serve as the final action for the CPP-603A Basins with an additional requirement for institutional controls. Institutional controls would be required after the removal action is completed to prevent access to the grouted mass. Once a decision is made on the final end state for the CPP-603 Complex, the removal action will be reevaluated in the context of the remaining actions for the CPP-603 Complex.

This removal action also is consistent with DOE's "Risk-Based End State Vision for the Idaho National Engineering and Environmental Laboratory Site (Draft)."[b] Based on the streamlined risk assessment presented in this document (Section 2.5), no cap will be necessary for the CPP-603 basins, but it has yet to be determined if a cap will be required for the rest of the facility after final deactivation, decontamination, and decommissioning.

Table 15. Summary of applicable or relevant and appropriate requirements for the recommended removal action.

Requirement (Citation)	ARAR Type	Comments
Clean Air Act and Idaho Air Regulations		
"Toxic Substances," IDAPA 58.01.01.161	A	Applies to the water, sludge, and debris removal and grouting activities.
"National Emission Standards for Hazardous Air Pollutants," <10 mrem/yr 40 CFR 61.92, "Standard"	A	Applies to the water, sludge, and debris removal and grouting activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A	Applies to the water, sludge, and debris removal and grouting activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A	Applies to the water, sludge, and debris removal and grouting activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.145, "Standards for Demolition and Renovation"	A	Applies to the water, sludge, and debris removal and grouting activities.

b. DOE-ID, 2004, "Risk-Based End State Vision for the Idaho National Engineering and Environmental Laboratory Site (Draft)," DOE/ID-11110, Rev. E, U.S. Department of Energy Idaho Operations Office, July 2004.

Table 15. (continued).

Requirement (Citation)	ARAR Type	Comments
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.154, "Standard for Active Waste Disposal Sites"	A	Applies to the water, sludge, and debris removal and grouting activities.
"Toxic Air Pollutants Non-carcinogenic Increments," IDAPA 58.01.01.585	A	Applies to the water, sludge, and debris removal and grouting activities.
"Toxic Air Pollutants Carcinogenic Increments," IDAPA 58.01.01.586	A	Applies to the water, sludge, and debris removal and grouting activities.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A	Applies to the water, sludge, and debris removal and grouting activities.
RCRA and Idaho Hazardous Waste Management Act		
Generator Standards:		
"Standards Applicable to Generators of Hazardous Waste," IDAPA 58.01.05.006, and the following, as cited in it:		
"Hazardous Waste Determination," 40 CFR 262.11	A	Applies to waste that will be generated during the removal action and disposed of at the ICDF.
Land Disposal Restrictions:		
IDAPA 58.01.05.011, "Land Disposal Restrictions," and the following, as cited in it:		
"Applicability of Treatment Standards," 40 CFR 268.40(a)(b)(e)	A	Applies to waste generated, if treatment is necessary to meet the disposal facility's waste acceptance criteria or if treatment is required because of placement.
Idaho Groundwater Quality Rules		
"Idaho Groundwater Quality Rule," IDAPA 58.01.11	A	The final configuration of the CPP-603 Basin Facility must prevent migration of contaminants from basins that would cause the Snake River Plain Aquifer groundwater to exceed applicable State of Idaho groundwater quality standards in 2095 and beyond.
To-Be-Considered Requirements		
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a, b)	TBC	Applies to the CPP-603 Basins before, during, and after the removal action. Substantive design and construction requirements will be met to keep public exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC	Applies to the CPP-603 Basins before, during, and after the removal action. Substantive design and construction requirements will be met to protect workers.
"EPA Region 10 Final Policy on Institutional Controls at Federal Facilities" (EPA 1999)	TBC	Applies if contamination is left in place at concentrations that preclude unrestricted access, after completion of the removal action.

A = applicable requirement; R = relevant and appropriate requirement; TBC = to be considered
ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CPP = Chemical Processing Plant
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
ICDF = INEEL CERCLA Disposal Facility
IDAPA = Idaho Administrative Procedures Act
RCRA = Resource Conservation and Recovery Act

7.3 Other Environmental Consequences

7.3.1 Geology and Soil Resources

7.3.1.1 Removal Action Effects. The removal action would have only minor, localized impacts on the INEEL Site's geology. Removal action activities would be of short duration and workers would reduce soil loss by keeping the areas of surface disturbance small. In addition, workers would reduce soil loss by using standard practices such as dust suppression and storm water run-off control, including sediment catchment basins, slope stability, and soil stockpiling with wind erosion protection.

7.3.1.2 Post-Removal Action Effects. Seismic and volcanic hazards for the INTEC area have been assessed (Woodward-Clyde Federal Services 1996; Hackett, Smith, and Khericha 2001). Ground motions to be expected probably are incapable of cracking or damaging the subsurface grouted basins resulting from the recommended alternative. Probabilities of inundation of the area by basalt lava flows are in the range of 10^{-6} per year. Even if the area were covered by basalt lava flow in the distant future, significant heating of the ground would extend for only 1 m beneath the present surface. This would not cause significant damage to the grouted basins.

7.3.2 Surface Water and Groundwater Resources

7.3.2.1 Removal Action Effects. The removal action would have negligible impact to either surface water or groundwater resources. Koslow and Van Haaften (1986) evaluated the potential consequences of a maximum 100-year flood event coupled with a Mackay Dam failure. The DOE estimates that the probability of an occurrence for this combined event is between 10^{-6} to 10^{-8} per year. This event would result in floodwater within the INTEC-controlled area up to 4,916 ft in elevation. This is an extremely conservative assumption, and it exceeds the requirements for a 10 CFR 1022 floodplain determination. Although the 4,916-ft elevation is extremely conservative, it was used to determine whether the alternatives identified in this environmental assessment are located within the 100-year riverine floodplain. It has been determined that the CPP-603A facility is at a 4,917-ft elevation; therefore, it is located outside the 100-year floodplain of the Big Lost River.

This removal action would not impact the floodplain and, based on existing studies, there is no risk of a riverine flood impacting the project under the alternatives. In addition, the removal action would adhere to the requirements in the *INEEL Storm Water Pollution Prevention Plan for Construction Activities—Generic Activities* (DOE-ID 1998). Therefore, this removal action would not significantly increase the probability of contaminants entering surface water or migrating to the Eastern Snake River Plain Aquifer.

7.3.2.2 Post-Removal Action Effects. Normal flows in the Big Lost River would not have any impact on the CPP-603A facility or its remnants. In addition, there would be no expected detrimental effects to the facility from the 100-year riverine flood event, since the elevation of the affected facilities is above the 4,916-ft elevation. The uncapped, grouted block would prevent the escape of contaminants for 500 years based on the analysis, which was modeled after the *Idaho High-Level Waste & Facilities Disposition Final Environmental Impact Statement* (DOE-ID 2002).

The potential risk to the groundwater pathway from the uncapped solid block of grout containing stabilized residual contaminants was evaluated using NCRP screening of the radionuclides and GWSCREEN simulation for the unscreened radionuclides and chemicals and metals (see Section 2.5 of this report). Both the peak concentrations in the aquifer and peak vadose zone pore-water concentrations were predicted. The peak concentrations were compared with both MCLs and risk-based limiting water concentrations. The limiting water concentration was defined as the concentration corresponding to 1×10^{-4} risk, the concentration corresponding to a hazard quotient equal to one or the MCL.

7.3.3 Biological Resources

7.3.3.1 Removal Action Effects. This removal action would have no direct or indirect negative impacts on the flora, fauna, endangered species, or ecology of the INEEL Site. Closure activities would not affect the existing environment outside the INTEC fence. Over the years, DOE has disturbed the area within the fence by constructing and paving roads and erecting buildings.

7.3.3.2 Post-Removal Action Effects. Long-term impacts to biological resources for the removal action would consist of continued lost productivity from the lands covered by the grouted basins, less than 0.6 acres for the CPP-603A facility.

7.3.4 Cultural Resources

7.3.4.1 Removal Action Effects. This removal action would partially destroy structures or portions of structures that are eligible for nomination to the National Register of Historic Places. In 1997, an inventory and historic significance assessment study of INEEL buildings were conducted. This study identified CPP-603A as eligible by contributing features in a potential historic district through its important and unique role in the nation's reactor fuel reprocessing program. Deactivation would proceed only in accordance with all the substantive requirements outlined in a memorandum of agreement signed with the DOE-ID, Idaho State Historic Preservation Office, and the Advisory Council on Historic Preservation. It is unlikely that any workers would directly impact any archaeological resources by activities concentrated within the fenced INTEC perimeter.

7.3.4.2 Post-Removal Action Effects. The INEEL's Cultural Resource Management Office does not expect long-term impacts to cultural resources, except the permanent occupation of the site by remnants of the grouted basins.

7.3.5 Land Use and Visual Resources

7.3.5.1 Removal Action Effects. The CPP-603A facility is located within the INTEC fence, an area that has been highly disturbed by paving and building. This removal action would not affect the current land use or visual resources near INTEC.

7.3.5.2 Post-Removal Action Effects. Most of the INEEL is open space that DOE has not designated for specific uses. Facilities and operations use about 2% of the total INEEL Site, primarily for nuclear energy research, waste management, and environmental restoration support operations. Public access to INTEC and other facility areas is restricted. The *Idaho National Engineering and Environmental Laboratory Comprehensive Facility and Land Use Plan* (DOE-ID 1997b) indicates that INTEC would remain an industrial area with no public access for at least 100 years in the future. Land use plans and policies for INTEC and other INEEL facilities identify continued energy research, waste management, and environmental restoration as the major INEEL business activities through the foreseeable future. This removal action is consistent with current and foreseeable land use plans and would be withdrawn from any potential future use.

The INEEL has long-distance views of rolling hills, buttes, and volcanic outcrops; and of the Lemhi, Lost River, and Bitterroot mountain ranges that border the INEEL Site on the north and west. The INTEC is located on a relatively flat area surrounded by undeveloped land that supports sagebrush-steppe grassland vegetation. However, 20-ft changes in elevation are common on the INEEL and even occur near INTEC. Other INEEL industrial facilities visible from INTEC include the Central Facilities Area, Test Reactor Area, Naval Reactors Facility, and Power Burst Facility. As a result of the removal action, the grouted basin would leave a 1- to 10-ft-high mound above ground level within the remaining CPP-603A structure. There would be no change to the exterior view of CPP-603A as a result of this removal action.

7.3.6 Waste Management

The actions proposed to remove basin water and sludge include generator treatment of hazardous materials as well as management of CERCLA waste in accordance with ARARs. All waste forms will be disposed of in appropriate landfills. Use of the ICDF for disposal of treated (stabilized) sludge and basin water has the lowest cost and worker risk if the material meets the facility waste acceptance criteria. Disposal of debris items in the Radioactive Waste Management Complex is consistent with current radioactive waste management practices.

This removal action will only generate small amounts of secondary waste, associated with the equipment and supplies required to pump water from the basins and to add grout to the basins. This secondary waste would be disposed of in an appropriate landfill.

8. PUBLIC PARTICIPATION

The INEEL will publish a notice of availability and a brief description of this EE/CA in the local newspaper (the Idaho Falls, Idaho, *Post Register*) and at least six other Idaho newspapers. The INEEL Community Relations Office may be contacted at (208) 526-3183 or (800) 708-2680. In accordance with the requirements of 40 CFR 300.415(m)(iii), the EE/CA and the Administrative Record file are available for a 30-day public comment period beginning on the date that this EE/CA is made available for public comment. In addition, DOE-ID will hold a public workshop to discuss and receive informal comments on this removal action.

Each significant public comment will have a written response and these responses will be made publicly available in the Administrative Record. Public comments will be considered in the development of the Action Memorandum.

9. REFERENCES

10 CFR 1022, 2003, "Compliance with Floodplain and Wetland Environmental Review Requirements," *Code of Federal Regulations*, Office of the Federal Register, September 2003.

36 CFR 800, 2004, "Protection of Historic Properties," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61, 2004, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61.45, 2004, "Standard for Demolition and Renovation," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61.92, 2004, "Standard," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61.93, 2004, "Emission Monitoring and Test Procedures," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61.94, 2004, "Compliance and Reporting," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61, Subpart H, 2004, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 61.154, 2004, "Standard for Active Waste Disposal Sites," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 141.61, 2004, "Maximum Contaminant Levels for Organic Contaminants," *Code of Federal Regulations*, Office of the Federal Register, June 2004.

40 CFR 261.24, 2004, "Toxicity Characteristic," *Code of Federal Regulations*, Office of the Federal Register, May 2004.

40 CFR 262.11, 2004, "Hazardous Waste Determination," *Code of Federal Regulations*, Office of the Federal Register, April 2004.

40 CFR 262.34, 2004, "Accumulation Time," *Code of Federal Regulations*, Office of the Federal Register, April 2004.

40 CFR 268, 2004, "Land Disposal Restrictions," *Code of Federal Regulations*, Office of the Federal Register, March 2004.

40 CFR 268.7, 2004, "Testing, Tracking, and Recordkeeping Requirements for Generators, Treators, and Disposal Facilities," *Code of Federal Regulations*, Office of the Federal Register, March 2004.

40 CFR 268.40, 2004, "Applicability of Treatment Standards," *Code of Federal Regulations*, Office of the Federal Register, March 2004.

40 CFR 300, 2004, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 300.415, 2004, "Removal Action," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

40 CFR 300.440, 2004, "Procedures for Planning and Implementing Off-Site Response Actions," *Code of Federal Regulations*, Office of the Federal Register, July 2004.

16 USC § 470 et seq., 1966, "National Historic Preservation Act," *United States Code*, October 15, 1966.

16 USC § 470aa–470mm, 1979, "Archaeological Resources Protection Act of 1979," *United States Code*, October 31, 1979.

42 USC § 4321 et seq., 1970, "National Environmental Policy Act," *United States Code,* January 1, 1970.

42 USC § 6901 et seq., 1976, "Resource Conservation and Recovery Act (Solid Waste Disposal Act)," *United States Code*, October 21, 1976.

42 USC § 9601 et seq., 1980, "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)," *United States Code,* December 11, 1980.

Demmer, R. L., 1996a, Letter to T. Waite, "Basin Sludge Calculations for CPP-603 Fuel Basins," RLD-08-96, Idaho National Engineering Laboratory, August 1996.

Demmer, R. L., 1996b, Letter to T. Waite, "Recalculation of Organic Data for CPP-603 Fuel Basins," RLD-11-96, Idaho National Engineering Laboratory, October 1996.

DOE, 1990, *Census of Population and Housing 1990, Public Law 94-171 Data*, CD ROM Technical Documentation, U.S. Department of Commerce, Bureau of Census, prepared in 1991.

DOE, 2001, *Deactivation, Decommissioning, and Dismantlement of the CPP-603 Basin Project, Draft Environmental Assessment*, DOE/EA-1368, Rev. 0, U.S. Department of Energy, June 2001.

DOE and EPA, 1995, *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),* U.S. Department of Energy, Washington, D.C., and U.S. Environmental Protection Agency, Washington, D.C., May 22, 1995.

DOE O 435.1, 2001, "Radioactive Waste Management," Change 1, U.S. Department of Energy, August 28, 2001.

DOE O 5400.5, 1993, "Radiation Protection of the Public and the Environment," Change 2, U.S. Department of Energy, January 7, 1993.

DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory,* Administrative Docket No. 1088-06-120, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare, December 9, 1991.

DOE-ID, 1994, *Track 2 Sites: Guidance for Assessing Low Probability Hazard Sites at the INEL*, DOE/ID-10389, Rev. 6, U.S. Department of Energy Idaho Operations Office, January 1994.

DOE-ID, 1995, *Record of Decision, Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs*, Document ID: 17033, Rev. 0, U.S. Department of Energy Idaho Operations Office, May 1995.

DOE-ID, 1997a, *Comprehensive RI/FS for the Idaho Chemical Processing Plant OU 3-13 at the INEEL—Part A, RI/BRA Report (Final),* DOE/ID-10534, Rev. 0, U.S. Department of Energy Idaho Operations Office, November 1997.

DOE-ID, 1997b, *Idaho National Engineering Laboratory Comprehensive Facility and Land Use Plan*, DOE/ID-10514, U.S. Department of Energy Idaho Operations Office, December 1997. (Official Use Only) Unclassified version is available at http://cflup.inel.gov/.

DOE-ID, 1998, *INEEL Storm Water Pollution Prevention Plan for Construction Activities—Generic Activities*, DOE/ID-10425(98), Rev. 2, U.S. Department of Energy Idaho Operations Office, May 1998.

DOE-ID, 1999, *Final Record of Decision, Idaho Nuclear Technology and Engineering Center*, *Operable Unit 3-13*, DOE/ID-10660, Rev. 0, U.S. Department of Energy Idaho Operations Office, October 1999.

DOE-ID, 2002, *Idaho High-Level Waste & Facilities Disposition Final Environmental Impact Statement*, DOE/EIS-0287, Rev. 0, U.S. Department of Energy Idaho Operations Office, September 2002.

DOE-ID, 2003, *Composite Analysis for the INEEL CERCLA Disposal Facility Landfill*, DOE/ID-10979, Rev. 0, U.S. Department of Energy Idaho Operations Office, August 2003.

EDF-1931, 2001, "Potential Air Emissions Associated with Deactivation, Decommissioning, and Dismantlement of the CPP-603A Basin Project," Rev. 0, Idaho National Engineering and Environmental Laboratory, May 2001.

EDF-1962, 2001, "Transport Simulation Approach for the Risk Assessment for Deactivation of INTEC Plant Building CPP-603," Rev. 0, Idaho National Engineering and Environmental Laboratory, May 2001.

EDF-3535, 2003, "CPP-603 Basins—Fissile Material in Particulate Form based on ^{137}Cs to ^{235}U Ratio," Rev. 0, Idaho National Engineering and Environmental Laboratory, August 2003.

EDF-3684, 2003, "Acceptable Residual Inventory Calculations for CPP-603," Rev. 0, Idaho National Engineering and Environmental Laboratory, May 2003.

EDF-4235, 2004, "CPP-603 Radionuclide Sample Results," Rev. 1, Idaho National Engineering and Environmental Laboratory, March 2004.

EDF-4271, 2004, "Quantification of Three Debris Objects from the South Basin of CPP-603 Using the Underwater Gamma Spectrometer System (TUGS)," Rev. 1, Idaho Completion Project, June 2004.

EDF-4488, 2004, "Streamlined Risk Assessment for the CPP-603 EE/CA," Rev. 1, Idaho Completion Project, June 2004.

EDF-4489, 2004, “Soil Contamination Groundwater Pathway Risk Assessment for CPP-603 Engineering Evaluation/Cost Analysis,” Rev. 1, Idaho Completion Project, June 2004.

EPA, 1990, *The Clean Air Act Assessment Package—1988 (CAP-88), A Dose and Risk Assessment Methodology for Radionuclide Emissions to Air*, Volumes 1–3, prepared by D. A. Beres, SC&A, Inc., for the U.S. Environmental Protection Agency, October 1990.

EPA, 1992, *Storm Water Management for Construction Activities—Developing Pollution Prevention Plans and Best Management Practices*, EPA 832-R-92-005, U.S. Environmental Protection Agency, Office of Wastewater Enforcement and Compliance, Washington, D.C., September 1992.

EPA, 1993, *Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA*, EPA 540-R-93-057, U.S. Environmental Protection Agency, August 1993.

EPA, 1999, Memorandum, “Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities,” U.S. Environmental Protection Agency, Region 10, Office of Environmental Cleanup, May 3, 1999.

Hackett, W. R., R. P. Smith, and S. Khericha, 2001, “Volcanic Hazards of the INEEL, Southeast Idaho;” in Bonnichsen, B., C. White, and M. McCurry, editors, *Tectonic and Magmatic Evolution of the Snake River Plain Volcanic Province, Idaho*; Geologic Survey Special Publication, in press.

IDAPA 58.01.01.161, 1995, “Toxic Substances,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, June 1995.

IDAPA 58.01.01.585, 1995, “Toxic Air Pollutants Non-Carcinogenic Increments,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, June 1995.

IDAPA 58.01.01.586, 1995, “Toxic Air Pollutants Carcinogenic Increments,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, June 1995.

IDAPA 58.01.01.650, 1994, “Rules for Control of Fugitive Dust,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1994.

IDAPA 58.01.01.651, 1994, “General Rules,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1994.

IDAPA 58.01.05.006, 2004, “Standards Applicable to Generators of Hazardous Waste,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, March 2004.

IDAPA 58.01.05.011, 2004, “Land Disposal Restrictions,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, March 2004.

IDAPA 58.01.11, 1997, “Ground Water Quality Rule,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, March 1997.

IDAPA 58.01.11.400, 1997, “Ground Water Contamination,” Idaho Administrative Procedures Act, Idaho Department of Environmental Quality, May 1997.

Koslow, K. N. and D. H. Van Haaften, 1986, *Flood Routing Analysis for a Failure of Mackay Dam*, EGG-EP-7184, Rev. 0, Idaho National Engineering Laboratory, June 1986.

Krupka, K. M. and R. J. Serne, 1998, *Effects of Radionuclide Concentrations by Cement/Ground-water Interactions in Support of Performance Assessment of Low-Level Radioactive Waste Disposal Facilities*, NUREG/CR-6377 or PNNL-11408, U.S. Nuclear Regulatory Commission, Pacific Northwest National Laboratory, May 1998.

NCRP, 1996, *Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground-Water*, NCRP Report No. 123, National Council on Radiation Protection, January 1996.

Rood, A. S., 1999, *GWSCREEN: A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination: Version 2.0 Theory and User's Manual,* INEEL/EXT-98-00750, Rev. 1, Idaho National Engineering and Environmental Laboratory, February 1999.

SAR-116, 2004, "Safety Analysis Report for the CPP-603 Basin Facility," Rev. 0, Idaho National Engineering and Environmental Laboratory, February 2004.

Tomlinson, G. E., INEEL, to B. T. Richards, INEEL, June 10, 2004, "Dose Estimate for INTEC-603 Basin Activities."

Woodward-Clyde Federal Services, 1996, *Site-Specific Probabilistic Seismic Hazard Analyses for the Idaho National Engineering Laboratory*, INEL-95/0536, Rev. 0, Idaho National Engineering Laboratory, May 1996.